1961

ANNUAL REPORT

FOR THE FISCAL YEAR ENDED JUNE 30

CHIEF OF ENGINEERS
U.S. ARMY
CIVIL WORKS ACTIVITIES

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

VOL. 1 OF TWO VOLUMES

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ANNUAL REPORT, DEPARTMENT OF THE ARMY
Fiscal Year Ended June 30, 1961

ANNUAL REPORT OF THE
CHIEF OF ENGINEERS

U.S. ARMY

ON CIVIL WORKS ACTIVITIES

1961

IN TWO VOLUMES

Vol. 1

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Volume I

Volume 2

Reports on individual project operations and related Civil Works activities published as a separate volume. For sale by Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price $5.50.

Statistics on Waterborne Commerce of the United States are printed separately. (See ch. VI, sec. 10.)

SUBJECT: Annual Report on Civil Works Activities for Fiscal Year 1961

TO: THE SECRETARY OF THE ARMY

1. The water resource development program of the Corps of Engineers includes the investigation, design, construction, and maintenance and operation of works for navigation, flood control, hydropower, water supply, recreation, fish and wildlife protection, pollution abatement, shore protection, and other water resource uses authorized by law.

2. Volume 1 of my annual report presents a summary of status and accomplishments, changes in policies, improved techniques, and planning to meet long-range future water requirements. It also provides a ready reference to summary data on water resource development by the Corps, regionally and nationwide.

3. Volume 2 contains detailed information on individual projects and programs. Detailed tabulations and national summaries of waterborne commerce are published separately.

4. The active Civil Works program as of June 30, 1961, consisted of about 3,400 project authorizations with a total estimated cost of about $18.7 billion. Appropriations through fiscal year 1961 for new work totaled about $10.1 billion, leaving about $8.6 billion still required. Appropriations during the year were $936 million, of which $756 million (81 percent) was for construction and $151 million (16 percent) was for operation and maintenance; the remaining $29 million (3 percent) was for preauthorization investigations, collection and study of basic data, research and development, and administration.

5. This program continues to provide widespread and large-scale benefits to the Nation. Items of major significance are—

(a) *Navigation.* Commerce on the Great Lakes during calendar year 1960 amounted to 99 billion ton-miles, and on the inland and intracoastal waterways system, 121 billion ton-miles. These two segments of our national transportation system carried more than 16 percent of the Nation's ton-mileage of freight. Total waterborne traffic of the United States amounted to 1,100 million tons, of which the distribution to 36 coastal harbors and channels, Great Lakes harbors and channels, and inland and intracoastal waterways was 47, 17, and 36 percent, respectively. The Great Lakes upbound connecting channels were deepened from 22 feet to 25 feet and will be further deepened by the end of the 1962 construction season, to the 27-foot depth of the St. Lawrence Seaway.

(b) *Flood Control.* Large-scale benefits have accrued to the Nation as a result of the Federal flood control program. Flood damage prevented by Corps of Engineers projects in operation is estimated to total about $10.6 billion through June 30, 1961, including over $868 million during fiscal year 1961. There was no major flood disaster during the year, although severe flooding occurred in the Lower Mississippi, Columbia, South Atlantic and East Gulf, Arkansas, and Ohio River Basins. Estimates indicate that in the Lower Mississippi Basin about $700 million in damage was prevented, and about $110 million in the other four basins. The remainder was prevented in other basins throughout the Nation.

(c) *Hydropower.* Corps of Engineers hydroelectric power activities, which began with operation of an 1,800-kilowatt plant on the

St. Marys River, Mich., in 1909, have grown into a program involving the operation of 6.9 million kilowatts of installed capacity and the generation of 27 billion kilowatt-hours of energy during the fiscal year. The generating capacity of the 32 hydro projects (34 powerplants) now in operation constitutes about 20 percent of the national hydroelectric capacity, and 3.5 percent of the total generating capacity (hydro and thermal) in the Nation. About the same percentages are applicable to the energy generated.

(d) *Water Supply.* The Corps provides about 1.5 million acre-feet of storage for water supply in 19 reservoirs serving about 40 cities. Some 4 million acre-feet of storage space is being utilized, either exclusively for irrigation, or jointly for irrigation and other purposes. Large quantities of water made available by power releases and evacuation of flood control storage improve the quantity and quality of downstream flows.

(e) *Public Recreation Use.* Both reservoirs and navigation projects furnish excellent opportunities for public recreation and make available approximately 3.2 million acres of water surface at normal pool levels and about 2.8 million acres of land area. Attendance at Corps of Engineers projects was 109 million during calendar year 1960, an increase of some 700 percent in the past 10 years.

6. As stated by the President in his first message to Congress on natural resources, "Our Nation has been blessed with a bountiful supply of water; but it is not a blessing we can regard with complacency. * * * Our available water supply must be used to give maximum benefits for all purposes * * *." I feel that the accomplishments under the Civil Works program during the past fiscal year represent a substantial contribution toward realization of optimum development of the Nation's water resources visualized in the President's message. In addition, measures inaugurated to insure a broadened perspective in planning future works, coupled with additional legislative authorities granted during the year, enhance the prospects for future contributions by the Civil Works program toward the ultimate objective of truly comprehensive water resource development.

W. K. WILSON, JR.
Lieutenant General, USA
Chief of Engineers

Classification	Cumulative through 1961	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951
I. APPROPRIATIONS [1] ($ millions) (fiscal year):												
A. New Work: [2]												
1. Navigation	3,183	211	209	190	141	135	88	42	25	31	47	48
2. Flood Control	3,970	286	286	278	226	212	143	91	82	148	151	173
2a. Flood Control, Mississippi River and Tributaries [3]	1,185	55	52	52	44	47	37	31	37	45	46	47
3. Multiple-Purpose Including Power	3,423	258	215	190	126	157	211	204	208	272	278	296
4. Beach Erosion Control	8	1	1	1	------	1	3	------	------	------	1	------
Subtotal, New Work	10,584	756	711	659	493	505	445	337	315	451	477	517
B. Other Work [4]	3,365	180	162	157	146	134	167	107	112	111	140	102
C. Total (A+B)	13,949	936	873	816	639	639	612	444	427	562	617	619
II. NAVIGATION (calendar year):												
A. Commerce (ton-miles) (billions):												
1. Coastal harbors and channels:												
1a. Foreign	(Not available, since much of this commerce moves via open-sea lanes)											
1b. Domestic deep-draft	----------	------	313	314	305	300	307	309	NA	NA	NA	NA
2. Great Lakes harbors and channels	----------	------	99	80	80	117	111	119	91	127	105	120
3. Inland and intracoastal waterways	----------	------	121	117	110	115	109	98	83	75	64	62
Subtotal 2+3	----------	------	220	197	190	232	220	217	174	202	169	182
B. Traffic (tons) (millions):												
1. Coastal harbors and channels	----------	------	514	497	480	522	498	437	377	374	379	388
2. Great Lakes harbors and channels	----------	------	191	166	158	217	211	216	171	222	188	211
3. Inland and intracoastal waterways	----------	------	395	389	367	392	384	363	320	328	321	325
Total	----------	------	1,100	1,052	1,005	1,131	1,093	1,016	868	924	888	924
III. FLOOD DAMAGES PREVENTED ($ billions) (cumulative by fiscal year)	----------	10.6	9.7	9.2	9.0	8.7	8.2	7.8	7.3	6.6	6.0	5.3
IV. POWER:												
A. Installed (kw millions) (cumulative)	----------	6.9	6.6	6.1	5.6	4.8	4.0	3.2	2.5	1.7	1.2	1.0
B. Generated (kwh billions) (fiscal year) [5]	----------	27.2	27.9	26.8	27.2	22.6	18.1	12.6	8.9	6.9	7.1	5.2
V. OTHER RELATED USES:												
A. Water supply and irrigation storage (cumulative) (million acre-feet)	----------	5.5	5.5	5.5	5.2	5.0	5.0	4.9	4.2	2.7	2.0	1.0
B. Attendance (millions) (calendar year)	----------	120	109	107	95	85	71	63	54	41	30	21
VI. RESERVOIR STORAGE (cumulative) (million acre-feet)	----------	164	162	155	153	150	144	120	115	87	74	60

[1] Includes about $0.5 billion expended on deferred-for-restudy, inactive, abandoned, or superseded projects.
[2] Advance Engineering and Design, and Construction.
[3] Included in 2.
[4] Operation and maintenance, surveys, administration, and miscellaneous.
[5] Cumulative through 1961: 225.1.

Classification	Number of projects				Total estimated Federal* cost (millions of dollars)			
	Total	Active	Deferred	Inactive	Total	Active	Deferred	Inactive
Navigation	2,604	2,450	42	112	6,138	5,477	343	318
Alteration of Bridges	20	19	0	1	50	49	0	1
Beach Erosion Control	90	81	3	6	41	38	2	1
Flood Control	1,163	772	114	277	7,735	5,633	851	1,251
Multiple-Purpose, Including Power	84	62	21	1	6,250	5,729	475	46
Mississippi River and Tributaries	1	1	0	0	1,768	1,768	0	0
Total	3,962	3,385	180	397	21,982	18,694	1,671	1,617

*Corps of Engineers costs only; excludes U.S. Coast Guard costs for associated aids to navigation.

TWENTY-FIVE YEARS OF NATIONAL FLOOD CONTROL[1]

By WILLIAM F. CASSIDY

Major General, United States Army

June 22, 1961, marked the twenty-fifth anniversary of the first legislation providing for Federal participation in flood control on a nationwide basis in the United States. Such a milestone is an appropriate vantage point from which to survey what has been accomplished by the Corps of Engineers, the principal Federal agency in this work, and, in perspective, take a look at the future needs of a growing nation.

Although active Federal participation in providing nationwide flood control is of relatively recent origin, there are early indications of Federal interest in the flood problem in such actions as passage of the "Swamp Land Acts" of 1849 and 1850, establishment of the Mississippi River Commission in 1879, and creation of the California Debris Commission in 1893. More direct action was taken with the authorization of flood control work by the Corps of Engineers on the Sacramento River in 1917, of the present comprehensive plan for the Alluvial Valley of the Mississippi in 1928, and of flood control works at Lake Okeechobee, Florida, in 1930. Finally, in the Flood Control Act of June 22, 1936, Congress established the present policy of Federal participation in flood control work throughout the nation. Under this and subsequent flood control acts a program of wide scope has been provided through which impressive gains have been made, although less than half of the Federal funds needed to complete the authorized work have been appropriated.

Authorized Program

The authorized flood control program of the Corps of Engineers consists of over 900 projects which have an estimated Federal cost of about $9 billion. With less than half of the required funds appropriated, projects having a Federal cost of $1.35 billion have been completed and additional projects with a Federal cost of $4.35 billion are under construction. About $5 billion in additional appropriations are required to complete projects now under construction and those authorized but not started. Projects completed or under construction include about 220 reservoirs with nearly 90,000,000 acre-feet of flood control capacity, over 9,000 miles of levees and floodwalls, and some 7,400 miles of channel improvements. Authorized projects not yet started would add 40,000,000 acre-feet of flood storage capacity in 120 additional reservoirs, almost 3,100 miles of levees and floodwalls, and 3,300 miles of channel improvements.

On the basis of the 1957 development of river valleys, it is estimated[2] that Corps of Engineers flood control works in operation may be credited with an average annual benefit of almost $500,000,000. Flood control works provided by other Federal agencies and by non-Federal interests increase this figure to over $600,000,000.

Aside from the benefits in flood damage prevention, the program contributes substantial benefits through multiple-purpose development of river basins. Perhaps the most outstanding contribution has been in power generation, where the Corps of Engineers is the biggest operator of hydroelectric power installations in the nation. The capacity of more than 6,500,000 kw now installed at Corps projects represents about one-fifth of the total hydroelectric capacity of the country, and produces some 27 billion kwh of electric energy annually. When all authorized projects are completed, it is estimated that the present installed capacity under the program will be almost tripled.

Another benefit of increasing importance in the flood control program is the provision of storage for municipal and industrial water supplies, for which

[1] Reprint of article originally printed in *The Military Engineer* for September–October 1961.

[2] In the report to the Senate Select Committee on National Water Resources, Select Committee Print No. 15, 86th Cong., 2d sess., July 1960, on "Floods and Flood Control."

repayment is made by the non-Federal beneficiaries. Over 3,500,000 acre-feet of storage for these purposes has been or is being provided in reservoirs completed or under construction. It may be expected that this type of multiple-use of reservoirs will increase greatly in the future in view of growing needs for water which can be met most effectively through complete regulation of major rivers.

Passage of the Water Supply Act of 1958 permits greater Federal participation in planning for and meeting future water supply requirements. An important contribution that has been made toward meeting the needs of water supply and pollution abatement has been through the augmentation of low flows by releases from conservation pools and normal releases incident to hydroelectric power generation. Such releases are of special benefit during periods of drought.

Other benefits include irrigation, for which about 4,000,000 acre-feet of exclusive or joint-use storage has been provided in reservoirs; fish and wildlife conservation; and the opportunities afforded for outdoor recreation.

The flood problem

Flood problems exist only where lands subject to inundation have been put to use in such manner as to be damaged by floods. Consequently, the national flood problem is constantly changing, not only because of flood flows but also because of the degree of man's encroachment upon natural flood plains. It is the encroachment element which explains why the flood problem in an expanding nation remains large, or actually increases, coincident with the provision of relatively large-scale effective flood control measures.

Unfortunately, there is no complete record of past flood damages in the United States. The best information available is that for the great floods which caused serious loss of life or major damage to property. These data show that between 1900 and 1940, when the Federal flood control program first began to be effective, floods causing the loss of 100 lives or more occurred on the average of about once every three years, but since 1940 the frequency of such floods has averaged only about once in ten years. A similar analysis of great floods on the basis of major property damage presents an entirely different picture. It shows that whereas floods causing property damage of $50,000,000 or more (1959 dollars) occurred with a frequency of about once every six years during the period between 1900 and 1940, floods causing this amount of damage have occurred on an average of once in less than two years since 1940. As this increasing frequency of floods causing major property damage is not caused by an increase in the magnitude of flood flows, it must be explained on the basis of the other component of the flood problem—that is, an increasing encroachment on the flood plains.

Army engineers have estimated the flood damage potential under the conditions in 1957 and under conditions of flood plain development expected in 1980. Only fragmentary data were available for the so-called "upstream" areas, consisting generally of drainage basins of less than 390 square miles. However, much information is available for the "downstream" areas, where the greater floods occur and where the activities of the Corps have been largely centered under the flood control program. For the downstream areas and for the upstream portion for which sufficient data were available to provide a reasonable basis for estimating, it was calculated that the national flood damage potential under 1957 conditions would average about $700,000,000 a year. For the same areas, assuming that no additional flood control works were to be put into operation, flood plain use, as it is expected to develop, would increase this potential to almost $960,000,000 annually by 1980. It is obvious that an effective program to counter the growing flood damage potential must be prosecuted vigorously.

Future program to 1980

The Corps of Engineers future flood control program to 1980 would consist of completion of projects now under construction, construction of the authorized projects not yet started, and provision of works which reasonably may be expected to be authorized within the selected future period. An additional Federal expenditure of about $6.5 billion would be required for construction of projects which might be expected to be authorized by 1980. Thus, the future program would involve total Federal costs of about $11.5 billion. The works that would be added to the authorized program would include about 400 reservoirs providing an additional flood storage capacity of over 64,000,000 acre-feet, 4,300 miles of levees and floodwalls, and about 5,900 miles of channel improvements.

Analysis of the effects of the projects included in the proposed future program showed that if all were in operation by 1980, the additional works would reduce the 1980 flood damage potential from $960,000,000 annually to about $483,000,000. Such a residue, being considerably less than the 1957 annual potential of almost $700,000,000, would represent very desirable progress toward elimination of the economic losses resulting from floods. To place this future program in operation by 1980 would require accelerating annual Federal appropriations from the present rate of about $300,000,000 to about $500,000,000 by 1970 and annually thereafter. If future appropriations continue at the present rate, it is estimated that by 1980 the flood damage potential would still amount to about $663,000,000 a year. In other words, continuing the flood control program at the present rate until 1980 would do little more than keep pace with the growth of damage potential during that period.

The estimated flood damage potential by 1980, even with an accelerated flood control program, emphasizes the need for action to regulate flood plain use to avoid, as far as possible, the creation of new flood problems. Compelling reasons frequently justify flood plain occupancy, with the alternatives of either suffering the recurring hazards and economic losses from flooding or incurring the cost of providing effective flood protection. Too often in the past, when suitable sites were readily available outside the danger zone, developments have taken place in hazardous areas with little thought of the consequences. Fortunately, states and local agencies, which have the basic responsibility for necessary regulatory measures, are displaying increasing interest in this phase of the flood problem. Legislation enacted in 1960 authorizes the Corps of Engineers to provide flood plain information to assist non-Federal agencies in planning the use and regulation of flood plain lands. Such measures coupled with an accelerated flood control program offer bright prospects of reducing to a fraction of the present figure the economic losses caused by the havoc of floods.

CHAPTER I

A PROGRAM FOR WATER RESOURCE DEVELOPMENT

1. SCOPE

The Civil Works program of the Corps of Engineers constitutes a major portion of the Federal plan for conserving, developing, and using the Nation's water resources. The program has grown until it constitutes a multimillion-dollar activity in the 50 States, the District of Columbia, and possessions, for navigation, flood control, hydropower, water supply, recreation, beach erosion control, and related purposes.

Navigation improvements at both coastal and Great Lakes harbors and channels generally involve the dredging of channels and anchorages and the protection of entrances and anchorages by jetties and breakwaters. Rivers are improved for navigation by dredging, regulating works, and canalization by locks and dams. Flood control is accomplished by increasing the carrying capacity of stream channels, by diversion channels, by reservoir storage of floodwaters, and by levees and floodwalls.

The program naturally affords possibilities for conservation and use of water resources. Reservoir projects often develop hydroelectric power; store water for industrial, municipal, and agricultural use; and improve low water flows. In many cases, the projects furnish large public recreational values, and preserve and enhance fish and wildlife resources. Congress has specified the areas to be investigated, prescribed the policies to be followed, and defined the limits of Federal participation.

2. STATUS

Federal activity in providing navigation improvements dates back to the River and Harbor Act passed in 1824. The major growth of the water resources program has come since 1928, when Congress adopted the project for the alluvial valley of the Mississippi and, particularly, since 1936 when Federal participation in flood control on a nationwide basis was first authorized. Details on the status of the active program are presented in appendix A, table 1.

3. ORGANIZATION

The Civil Works mission is accomplished through a decentralized organization comprising 11 divisions which are subdivided into 38 districts completely covering the United States and its oversea possessions. Boundaries between divisions are selected so as to place, to the extent practicable, a river basin or coastal area within a single division.

The field offices, administered by officers of the Corps of Engineers, employ about 27,000 civilians engaged in Civil Works, exclusive of contractors' personnel.

Summary status of the active Civil Works Program as of June 30, 1961:

Status	Number of projects and/or project authorizations	Estimated cost 1961	Appropriations through fiscal year 1961	Required to complete after fiscal year 1961
		(Millions of dollars)		
Completed or substantially completed	2,667	3,840	3,801	39
Under construction	439	10,913	6,231	4,682
Authorized, not started	279	3,941	29	3,912
Total	3,385	18,694	10,061	8,633

CHAPTER II

BENEFITS OF THE PROGRAM

Since 1824, the Corps of Engineers has built and maintained the Nation's harbors and navigable waterways. Since 1936, when the Federal Government assumed responsibility for nationwide flood control, the Corps has been assigned the major responsibility for carrying out that task. The active program, including the $1.8 billion Mississippi River and tributaries project authorized in 1928, consists of about 3,400 project authorizations and/or projects authorized by law, having an estimated cost of $18.7 billion. Projects costing $3.8 billion have been completed, and an additional $6.2 billion has been invested in projects under construction. Uncompleted portions of work underway, and authorized projects not started, aggregate about $8.7 billion. The water resources projects now in operation have reduced transportation costs, reduced flood damages, and provided electric energy, water supply, irrigation, low flow regulation, recreational development, and preservation and enhancement of fish and wildlife.

1. NAVIGATION

The navigation element consists of three major parts: coastal harbors and channels, Great Lakes harbors and channels, and inland and intracoastal waterways. In 1960 deep-draft traffic in coastal harbors and channels amounted to 514 million tons of foreign and domestic commerce. There moved on the Great Lakes 191 million tons and on the inland waterways 395 million tons. These three elements aggregate 1,100 million tons. The total Great Lakes and inland and intracoastal waterways movement amounted to 220 billion ton-miles, of which 99 billion moved on the Great Lakes and 121 billion on the inland and intracoastal waterways. Each of these three systems has, by savings in transportation costs, more than justified construction and operating costs. (An analysis of that program, based on 1953 costs and commerce, is contained in ch. III, vol. 1, of the 1955 Annual Report.)

Coastal harbors and channels. Natural harbors and channels are being progressively improved to provide the greater depths required for ocean carriers of today. Depths of 35 feet now generally prevail at major harbors on the Atlantic and Gulf coasts, ranging up to 45 feet in New York Harbor. Depths of 30 to 40 feet are generally available along the Pacific coast. Harbors and channels of lesser depth also have been provided for commercial fishing, recreational boating, and harbors of refuge.

Great Lakes harbors and channels. These vast water areas, joined by the connecting channels, provide a low-cost transport artery that permits movement of materials and products in huge quantities to

advantageously located industrial areas. Controlling depths in the connecting channels are now generally 25 feet in both upbound and downbound channels. Improvements to provide depths of at least 27 feet are underway and scheduled to be usable in 1962.

The Great Lakes are connected with the Gulf of Mexico by means of 9- to 12-foot barge navigation on the Illinois Waterway and Mississippi River. Connections with the Atlantic Ocean are provided by the New York State barge canal system and Hudson River, and by the 27-foot St. Lawrence Seaway.

There are 58 federally improved harbors on the Great Lakes with project depths of 18 feet or more, of which 17 provide depths of 25 feet or more. The omnibus River and Harbor and Flood Control Act, approved July 14, 1960, authorized further improvement of many of these harbors to provide depths consistent with those being provided in the connecting channels.

Inland and intracoastal waterways. These waterways have proved their worth as routes for low-cost movement of bulk commodities to supplement the major forms of overland transport.

The Federal Government has improved in varying degree some 22,200 miles of inland waterways, of which about 19,000 miles are currently in commercial use. Ton-mileage on the inland and intracoastal waterways increased 3.5 percent during the past year, to establish a new record of 121 billion.

2. FLOOD CONTROL

The first major Federal participation in flood control began in 1928 when Congress adopted the present project for flood control and navigation in the alluvial valley of the Mississippi. The responsibility for nationwide flood control was assigned to the Corps of Engineers by the 1936 Flood Control Act, which also established the Federal policy for that activity.

The flood control program, including the $1.8 billion Mississippi River and tributaries project, is estimated to cost $7.4 billion. Since 1936, the Corps of Engineers has completed about 400 projects having a cost of over $1.1 billion. Projects having an estimated cost of over $4.8 billion are under construction, and the remainder of the active flood control program, estimated to cost $1.4 billion, has not been started. Many multiple-purpose reservoir projects with power also provide important flood control benefits.

Corps of Engineers projects have been highly effective in reducing flood damages. During the limited period they have been in operation (generally averaging less than 14 years), they have prevented flood damages of nearly $10.6 billion. Over $868 million of flood damage was prevented during fiscal year 1961. Table 1 appendix C, indicates flood damages prevented during the fiscal year and the cumulative totals to date.

The Nation will remain vulnerable to severe flood damage from major floods until an adequate degree of protection is achieved. This goal may be reached through orderly prosecution of existing flood control plans, expanded to meet economic development taking place in flood plains. The results from operating flood control projects prove that much of the flood damage now experienced can be eco-

nomically prevented. Major floods occurred in the Lower Mississippi Valley in May 1961, in the South Atlantic and East Gulf region in July–September 1960 and in November–December 1960, in the Arkansas Basin in May 1961, and in the Ohio Basin in February–July 1961. Flood damages were not severe, as existing works prevented more than $700 million in flood damages in these four regions.

3. HYDROELECTRIC POWER

The position of hydroelectric power development in the Civil Works program has grown with the increasing needs of the Nation for electric energy, with the greater knowledge accumulated in recent years of the ability of rivers to supply that power, and as a result of the expanding Federal interest in its development and use.

The Civil Works program, involving the construction of reservoirs, has afforded wide possibilities for the development of waterpower. Hydroelectric power production at Corps' projects in operation during fiscal year 1961 amounted to 27.2 billion net kilowatt-hours of electric energy. This represents about 20 percent of the hydroelectric power production, and about 3 percent of the total electric production, from all public and private electrical generating plants in the Nation. Table 1, appendix D, shows installed capacity and generation at Corps' projects.

4. WATER SUPPLY

Domestic and industrial. Growth of population and increased demands of manufacturing processes have focused the attention of public officials on the need for adequate amounts of water of suitable quality. Adequate water supplies are a problem for many communities and the availability of additional supplies will greatly affect their future growth and the development of new industries.

For many years the Corps of Engineers has had legislative authority to provide storage for water supply, provided local interests pay the cost. The Water Supply Act of 1958, as amended, provided a broadened authority by permitting consideration of water supply storage for future needs as well as present needs. Under that act and the various prior authorities, numerous communities have obtained water supplies from Corps of Engineers reservoirs. At present, the Corps of Engineers is providing about 1.5 million acre-feet of water storage in 19 reservoirs for more than 40 cities. About 1.7 million acre-feet of additional water supply storage will be provided by 14 projects under construction, as listed in table 1, appendix E.

Low-flow regulation. Conservation releases of almost 8 million acre-feet, together with 29 million acre-feet from hydropower generation, improved the quantity and quality of downstream flows, which benefited water supplies, recreation, and fish and wildlife.

Irrigation. About 4 million acre-feet of irrigation storage space is being operated either exclusively for irrigation, or jointly for that and other uses, as shown in table 2, appendix E. An additional 827,000 acre-feet of joint-use storage will be provided by projects under construction.

5. PUBLIC RECREATION USE

Civil Works lands and waters are being used by more and more people for a greater variety of public recreation opportunities. On

reservoir projects particularly, picnicking, swimming, boating, fishing, and camping are the most popular activities, with family camping and water skiing showing the fastest growth and presenting the biggest problems of management. Total attendance increased to 109 million in calendar year 1960. Watercraft on the peak day increased from 119,000 to a new record of 169,000.

The majority of the recreational facilities and services available to the public at Civil Works projects are provided or are planned to be provided at other than Federal expenditure, either by public agencies (State, county, or municipal) or by commercial concession arrangements. Most of the Federal expenditures are made in providing access roads, parking areas, boat launching ramps, water wells, and toilets. Concessionaires have also enlarged their facilities, particularly those providing boat care and overnight accommodations.

During recent years the growth in use of recreational facilities at Civil Works projects has been at a much higher rate than the growth in facilities provided, as indicated in the following table.

Growth in Public Recreational Facilities and Use

	Calendar year		Percent of increase
	1956	1960	
Facilities:			
Access points (vehicular)	2,800	3,500	25
Boat launching ramps	1,100	1,900	73
Picnic grounds	900	1,200	33
Campgrounds	500	600	20
Organized camps	180	220	22
Use:			
Watercraft (peak day)	73,000	168,000	130
Attendance (millions)	71	109	54

An outstanding public use area is Lake Sidney Lanier, on the Chattahoochee River in Hall County, Ga. Since the reservoir was placed in operation in 1957, attendance has grown to 5.1 million in calendar year 1960. (Attendance during this period at the Allatoona Reservoir, some 30 miles distant, increased from 1.5 to 2.5 million.) Present public use facilities at the Sidney Lanier project include about 39,000 acres of water area, 39 vehicular access points, 27 public boat launching ramps, 11 picnic areas, and an organized camp. Over 2,000 watercraft were in use on the peak day. About 130,000 pounds of sport fish were caught during the year. State and other local interests are continuing to provide facilities to meet increased uses and needs.

6. FISH AND WILDLIFE

Fishing and hunting days comprise a significant percentage (probably 5 to 10 percent) of the 109 million public attendance at Corps' projects in 1960. There has been a steady increase in fishing and hunting licenses in counties adjacent to such projects. Fish and waterfowl resources are enhanced by the water area of 3.2 million acres. Game management on 2.8 million acres of project lands above normal water areas has in many instances compensated for loss of natural habitat by inundation. A catch of more than 21 million pounds of sport fish was reported, but this does not represent the total sport fish caught nor does it include the commercial fish taken.

CHAPTER III

PLANNING

1. POLICY MATTERS

The Corps of Engineers continued participation with other Federal agencies and with agencies of the various States in the development of national water resource policies. In addition, various policies and procedures in use by the Corps of Engineers were reviewed, improved, and modified. The more important of these activities are discussed in the following paragraphs.

The Interagency Committee on Water Resources is composed of policy officials at the secretarial level of the Departments of Agriculture; Army; Commerce; Health, Education, and Welfare; Interior; and Labor; and the Federal Power Commission. The committee establishes means and procedures to promote coordination of the water and related land resources activities of the member agencies, undertakes resolution of interagency differences, suggests to the President changes in policy that would promote coordination and reduce differences, and reviews problems referred to it by field committees. Field committees have been set up for the Missouri, Columbia, Pacific Southwest, and Arkansas-Red-White Basins, and the New England area. The committee performed its regular activities principally through its subcommittees on hydrology, sedimentation, and evaluation standards. The Interagency Committee adopted a subcommittee's report on a proposed interim schedule of values for recreational aspects of fish and wildlife as a basis for further study and for interim use by the participating agencies, as an aid to judgment in preparing project reports, pending further improvements in methods of evaluation.

Watershed protection and flood prevention. The Corps of Engineers and the Department of Agriculture continued to improve coordination of plans for small headwater reservoirs developed under the authorities of Public Law 566 (the Watershed Protection and Flood Prevention Act of 1954, as amended) with the plans prepared under the flood control acts. The Department of Agriculture has continued cooperative studies in the Delaware, Potomac, and Cape Fear River Basins, all of which were initiated prior to fiscal year 1960. These studies are expected to lead to the development of comprehensive and coordinated basinwide plans.

During fiscal year 1961 the Corps of Engineers reviewed 62 Public Law 566 plans and submitted comments thereon to the Secretary of the Army as a basis for the views and recommendations which he submits to the Secretary of Agriculture, pursuant to the provisions of Public Law 566. This increases to 254 the total number of watershed work plans reviewed by the Corps of Engineers since initiation of the Public Law 566 program.

Aquatic Plant Control. Field operations have been continued on the pilot project for progressive control and eradication of noxious aquatic plants in the South Atlantic and Gulf Coast States. These operations have reduced maintenance requirements for navigation channels. Techniques have been improved by research carried out with cooperating Federal and State agencies.

Pumped Storage Hydroelectric Plants. Technological advances and the continuing growth in demands for power have greatly increased the possibilities of supplying part of the Nation's power needs by pumped storage hydroelectric plants. Reservoir projects constructed or being planned by the Corps of Engineers create many opportunities for the development of pumped storage power, and Corps planning procedures have been expanded to insure full consideration of this relatively new aspect of water resource development.

Amendment of Water Supply Act of 1958. The Water Supply Act of 1958 was amended by section 10 of the Federal Water Pollution Control Act Amendments of 1961 (Public Law 87–88) to provide that future demand storage for municipal and industrial purposes may be provided in reservoir projects if States or local interests give reasonable assurances, and there is evidence that demands for the storage will be made within a period of time which will permit paying out the costs allocated to water supply within the life of the project. Preparation of instructions to field installations was initiated.

Low flow regulation for water quality control. Section 2 of the Federal Water Pollution Control Act amendments of 1961 (Public Law 87–88, approved July 20, 1961) provides for the inclusion of storage in reservoirs for the regulation of streamflow for water quality control, except that any such storage and water release may not be provided as a substitute for adequate treatment or other methods of controlling waste at the source. The act also requires that the advice and review of the Secretary, Department of Health, Education, and Welfare, be obtained concerning this subject. Extensive staff study and coordination with the Department of Health, Education, and Welfare will be required to implement this important new authorization.

Moratorium on disposal of lands. In order to carry out the policy of the administration, as set forth in the President's message of February 23, 1961, to Congress relative to natural resources, steps have been taken to insure that land acquired for the construction of federally financed reservoirs is sufficient to permit future development for recreational purposes. Studies are being made with a view to revising the joint Army-Interior policy on acquisition of lands for reservoir projects. The principal objective of the revision will be to preserve and protect for future public use and development the recreational potential created by such reservoirs. A moratorium on disposal of reservoir lands is contemplated, pending the completion of these studies, to insure that lands previously acquired for existing reservoirs which have a potential for recreational use will not be declared excess to the needs of the project.

Remedial works (relocations). Section 111 of the River and Harbor Act approved July 3, 1958 (Public Law 85–500), provides that a governmental structure or facility adversely affected by construction of a project may be altered or paid for with project funds.

Section 207(b) of Public Law 86–645 approved July 14, 1960 states:

That, for such water resources projects, under construction or to be constructed, when the taking by the Federal Government of an existing public road necessitates replacement, the substitute provided will as nearly as practicable serve in the same manner and reasonably as well as the existing road. The Chief of Engineers is authorized to construct such substitute roads to design standards comparable to those of the State in which the road is located, for roads of the same classification as the road being replaced. The traffic existing at the time of the taking shall be used in the determination of the classification.

Policy instructions concerning interpretation and application of the above legislation have been furnished the District and Division Engineers.

International boundary water studies. Pursuant to the treaty of 1909 between the United States and Great Britain relating to boundary waters between the United States and Canada, the International Joint Commission was organized in 1911. In general, the Commission exercises jurisdiction over matters involving the use, obstruction, or diversion of boundary waters. When such matters are assigned by the respective governments to the Commission for investigation and/or resolution, they are generally designated as "References." The Commission is empowered to utilize the services of Government agencies in both countries in carrying out the terms of such references. The Corps of Engineers has continued participation as a member of the following boards established by the Commission.

International Columbia River Engineering Board. This Board was appointed in April 1944 to report on further development of the water resources of the Columbia River Basin. An International Engineering Committee, composed of Federal, State, and Provincial representatives, was established by the International Engineering Board. For several years the Chief of Engineers has served as Chairman of the U.S. Section of the Board.

International Souris-Red Rivers Engineering Board. The Board was established by the Commission in April 1948. The Board is presently concerned with a study of the Pembina River.

International Passamaquoddy Engineering Board. In accordance with Public Law 401, 84th Congress, and the Boundary Waters Treaty of 1909, Canada and the United States in 1956 directed the International Joint Commission to investigate the feasibility of developing the tides of Passamaquoddy and Cobscook Bays in New Brunswick and Maine for power. An International Passamaquoddy Engineering Board was one of two boards established by the Commission to make the study. The Engineering Board appointed an Engineering Committee to conduct the necessary studies. The Division Engineer, U.S. Army Engineer Division, New England, served as chairman of the U.S. Section of the Engineering Committee. The Engineering Board submitted its report to the International Joint Commission in October 1959. In April 1961 the Commission transmitted its report to the two Governments.

International St. Croix River Engineering Board. This Board was appointed by the Commission in September 1955 to determine whether further development of the water resources of the St. Croix

River would be practicable and in the public interest. The report of the Engineering Board was submitted to the International Joint Commission in September 1957. The Commission's report is awaiting further action by the Governments of Canada and the United States.

International Saint John River Engineering Board. The International Joint Commission appointed the International Saint John River Engineering Board in October 1950 to undertake field investigations to determine whether the waters of the Saint John River system could be more beneficially conserved and regulated, and to recommend what projects in the Saint John River Basin, above Grand Falls, New Brunswick, would be practical in the public interest. The reference was enlarged in July 1952 to include all of the Saint John River system above tidewater near Fredericton, New Brunswick. In April 1953 the Engineering Board transmitted to the Commission an interim report. The Commission's interim report, dated January 27, 1954, was transmitted to the two Governments in April 1954.

International Boundary and Water Commission, United States and Mexico. This Commission was established pursuant to the Water Treaty of 1944 with Mexico, which deals with the utilization of waters of the Colorado and Tijuana Rivers and the Rio Grande. Falcon Dam on the Rio Grande, 130 miles upstream from Brownsville, Tex., was the lowermost and first to be built (completed in 1953) of the international storage dams provided for by the Water Treaty. The authorized Amistad Dam and Reservoir (formerly known as Diablo Dam), on the Rio Grande, is located 290 river-miles upstream from Falcon Dam. At the request of the Commission, the design of Amistad Dam is being undertaken by the U.S. Army Engineer Division, Southwestern, Dallas, Tex.

2. AUTHORIZATION ACT OF 1960

Public Law 86–645, the Omnibus River and Harbor and Flood Control Act was signed by the President on July 14, 1960. The act increased monetary authorization and authorized new works with a current estimated cost of $1,445,694,300, of which $1,385,694,300 is for work by the Corps of Engineers.

The Corps' work is broken down as follows:

Title I. Rivers and Harbors:	
Navigation projects or project modifications	$203, 519, 300
Beach erosion control projects	22, 345, 800
Monetary authorization (Barkley Dam, Ky.)	146, 000, 000
Total title I	371, 865, 100
Title II. Flood Control:	
New projects or project modifications	277, 589, 200
Increased basin authorizations	736, 240, 000
Total title II	1, 031, 829, 200
Grand total	1, 385, 694, 300

The act (sec. 109) also authorizes 19 navigation and (sec. 208) 11 flood control surveys to be carried out in 13 States.

Section 107 of the act authorizes the construction, when found advisable by the Chief of Engineers, of small navigation projects for which the Federal share does not exceed $200,000. There is already similar

authority for small flood control projects costing not over $400,000. Section 206 of the act empowers the Chief of Engineers, upon the request of State or local governments, to provide flood plain information to aid them in planning and regulating the use of such areas and to ameliorate future flood hazards.

3. PROJECT DEVELOPMENT

During the year the Public Works Committees of Congress adopted 86 resolutions requesting review of previous reports on proposed river and harbor and flood control improvements.

In addition, the River and Harbor and Flood Control Act of 1960, Public Law 86–645, contains authorizations for surveys of 29 locations and 15 special reports.

Developments in survey procedures. Preparation and updating of engineering manuals on survey report procedures was continued during the year. Interagency coordination continued.

Current survey program. The status of the current survey program is summarized in the following table. Several special studies that are elements of the survey program are discussed in subsequent paragraphs.

Reports Processed and Status at End of Year

Reports transmitted to—	Number
Congress	47
Bureau of the Budget	56
State and Federal agencies	94
River and harbor and beach erosion boards	101
Total actions	298
Status as of June 30, 1961	
Favorable reports before Congress	14
Reports in process in Office, Chief of Engineers	21
Active reports in field offices	391
Special studies active in field offices	12
Inactive reports in field offices	683
Special studies inactive in field offices	1
Total reports	1,122

Columbia River and tributaries review. The comprehensive report of the Division Engineer was completed early in fiscal year 1959. Coordination has been maintained with Federal, State, and local agencies. The Board of Engineers for Rivers and Harbors prepared its report, and the proposed report of the Chief of Engineers was prepared and distributed to Federal and State agencies for comment.

Delaware River comprehensive review. A comprehensive review investigation of the Delaware River Basin was completed by the District and Division Engineers. They proposed a plan consisting of 11 major water control projects for multiple-purpose development for flood control, water supply, recreation, power, and other purposes; 8 major water control projects for development initially for recreation and later additional development for water supply; 39 small flood control projects, all of which can be accomplished under existing programs; and related supplemental programs. Exchange of information and views was accomplished during the investigation by a

coordinating committee with Federal, State, and local representation. Review of the District and Division Engineers' three reports was initiated by the Board of Engineers for Rivers and Harbors and the Chief of Engineers.

Comprehensive survey of Great Lakes harbors. The St. Lawrence Seaway and Great Lakes connecting channels projects will provide a waterway with minimum depth of 27 feet throughout the Great Lakes system, connecting with the Atlantic Ocean. The deeper draft traffic expected necessitates reexamination of harbors. Such studies have been authorized. A comprehensive traffic study of waterborne commerce underway is scheduled for completion in June 1962. More than 50 harbors will be considered. Interim reports are being prepared on 34 harbors, and the remaining harbors will be covered in the final report, scheduled for completion in June 1962. Reports recommending improvement at 17 harbors were authorized by the 1960 River and Harbor Act. Reports on three additional harbors have been submitted to Congress. Interim reports on 21 harbors are scheduled for submission by reporting officers during fiscal year 1962.

Hudson River siltation study. This authorized study will determine improvements necessary and feasible to lessen shoaling in pier slips along the Hudson River and the Federal channel at Edgewater, N.J. Office studies, including analysis of model studies, are underway.

Hurricane flood protection study. Hurricanes cause heavy loss of life and damage to property. Public Law 71, 84th Congress, authorized study of the coastal and tidal areas along the eastern and southern seaboards. This study, being made in cooperation with Federal and State agencies, was continued during the fiscal year. Initial appraisals have been completed. Interim reports on some 44 areas were in progress.

Ohio River comprehensive review. This authorized comprehensive review has the objective of developing a program to serve adequately the needs of the area. Coordination is being maintained with interested Federal, State, and local agencies. The flood control aspects are well advanced. Study of water supply and related aspects is being initiated.

Potomac River comprehensive review. This authorized comprehensive review was continued. Attention to water supply and stream pollution comprises an important part of the study. Coordination is being maintained with Federal, State, and local agencies. An interim report on the North Branch basin was completed by the District and Division Engineers, and its review was initiated by the Board of Engineers for Rivers and Harbors and the Chief of Engineers.

Survey of the San Francisco Bay area. An authorized comprehensive survey of the San Francisco Bay area is in progress. The study will include navigation requirements, flood control, reclamation of marginal lands, water supply, salt water intrusion, sedimentation, and other water problems. Model studies are being used. Coordination is being maintained with State and local interests.

Mississippi River and tributaries project review. A comprehensive review of the project for flood control on the Mississippi River in the alluvial valley, published in House Document 359, 77th Congress, has been authorized by Congress. This study involves reexam-

ination of existing works evolved over a period of more than 30 years to determine their adequacy and the need for any extensions or modifications of the authorized project. The Mississippi River Commission has submitted a report on the study, and the report of the Chief of Engineers proposing improvements for the main stem of the Mississippi River and many of its tributary basins has been prepared and transmitted to interested State and Federal agencies for review and comment.

4. BOARD OF ENGINEERS FOR RIVERS AND HARBORS

The Board held five meetings of 1 to 2 days' duration. The Board considered 65 reports, acting favorably on 37, unfavorably on 24, deferred action on 1, and returned 3 to the reporting officers for further consideration. The Board recommended authorization of projects estimated to cost $479 million, of which $437 million is the estimated cost to the United States, and $42 million the cost to local interests.

5. BEACH EROSION BOARD

The Beach Erosion Board completed action on seven beach erosion control studies in cooperation with local public agencies during the fiscal year and assisted State agencies in setting up the study programs for five new cooperative studies, as indicated in the table below.

BEACH EROSION CONTROL—COOPERATIVE STUDIES COMPLETED AND APPLICATIONS APPROVED

Cooperative Studies Completed During Year

Belle Pass to Raccoon Point, La.
Carolina Beach, N.C.
Fernandina Beach (Amelia Island), Fla.
New Hampshire (Atlantic Ocean Shore).
Palm Beach County, Fla. (phase 2).
Sheffield Lake Village, Ohio.
Virginia Beach, Va. (review).

Applications for Cooperative Studies Approved During Year

Fire Island Inlet to Jones Inlet, N.Y. (review).
Fort Pierce, Fla.
Martha's Vineyard, Mass.
Newport, R.I.
Perth Amboy, N.J.

During the year 12 reports and 1 design memorandum were reviewed for probable effects of navigation improvements on adjacent shore lines. In addition hurricane protection was considered in the combined hurricane-beach erosion control report on Carolina Beach, N.C., and 11 other hurricane survey reports were reviewed.

Results of the research investigations conducted by the Board are made available to the using public in the form of publications. During the year 8 technical memoranda and an annual bulletin were issued.

Two classes of 3 weeks' duration each were conducted at the Beach Erosion Board offices to instruct staff engineers from U.S. Army Corps of Engineers District and Division offices in coastal engineering.

During the year, 27 distinguished foreign visitors from 15 foreign countries toured the Board's research facilities and discussed various phases of shore protection or research in coastal engineering with the

staff. These distinguished visitors included the Engineer-in-Chief of the British Army and the Inspector General of the French Army Engineers.

6. ADVANCE ENGINEERING AND DESIGN

A backlog of projects ready for initiation of construction is in preparation to allow inclusion as the national budgetary policy permits, at the same time assuring the development of a sound and well-balanced program consistent with the Nation's needs. This preparation includes firm cost estimates, construction schedules, and detail for coordination with local interests.

With $12,604,026 made available, together with funds carried over from prior years, planning was prosecuted on 132 projects, consisting of 34 navigation, 89 flood control, and 9 multiple-purpose projects. Planning on 54 of these projects was advanced to the stage where construction could be readily initiated. Funds in the amount of $12,090,462, representing approximately 81 percent of the total available, were obligated.

7. COLLECTION AND STUDY OF BASIC DATA

The collection and study of basic data are indispensable to the planning, design, and operation of Corps' river-basin projects. This item includes those cooperative activities performed by other Federal agencies. Funds are provided for the basic programs of observing, compiling, reporting, and publishing data on streamflow, rainfall, and fish and wildlife resources. In addition, field offices of the Corps of Engineers conduct activities related to the study and control of international streams which affect the United States and Canada.

a. Cooperative programs with the U.S. Weather Bureau.

(1) Operation of a network of rainfall gages, known as the Hydroclimatic Network, was continued by the Weather Bureau at the request of the Corps of Engineers. Funds in the amount of $475,000 were transferred to the Weather Bureau. A total of 2,731 stations (2,280 recording and 451 nonrecording) were in operation on June 30, 1961. Data are published monthly by the Weather Bureau in "Hourly Precipitation Data."

(2) The Hydrometeorological Section of the Weather Bureau continued the storm study program and the development of the theoretical concepts and practical techniques of estimating probable maximum precipitation for use in engineering design. Funds in the amount of $118,000 were made available to the Weather Bureau to finance continued operation of this section. Accomplishments include completion of a report on probable maximum precipitation in California; preparation of a report on probable maximum precipitation in Alaska and initiation of a similar report for Hawaii; estimates of probable maximum precipitation for four project areas; publication of Hydrometeorological Report No. 38, "Meteorology of Flood-Producing Storms in the Ohio River Basin"; publication of Weather Bureau Technical Paper No. 15, "Maximum Station Precipitation for 1, 2,

3, 6, 12, and 24 Hours," for Oklahoma; review of several storm studies and other investigations.

(3) The River and Rainfall Reporting Networks, currently totaling 39 in number, were continued. These data are required for flood-forecasting purposes and for operation of river improvement projects. Funds in the amount of $126,100 were transferred to the Weather Bureau for this program.

b. Stream-gaging program with the U.S. Geological Survey. The Geological Survey was requested to continue the cooperative program of operating stream-gaging stations required by the Corps of Engineers. A total of $1,671,250 was transferred to the Geological Survey for the construction and operation of approximately 1,870 stations. Data from these stations are published by the Geological Survey in its Annual Water Supply Papers.

c. Studies by the U.S. Fish and Wildlife Service. Funds were made available to the Fish and Wildlife Service for continuation of study of the effects of Corps of Engineers projects upon fish and wildlife resources and for enhancement of these resources, in accordance with the Fish and Wildlife Coordination Act, Public Law 85–624. A total of $50,000 was transferred to the Fish and Wildlife Service from appropriations for "General Investigations of the Corps of Engineers." Data from these studies and recommendations by the Service are incorporated in Survey Reports of the Corps submitted to Congress.

d. International water studies. In order to carry out U.S. obligations under international agreements, several Divisions and Districts of the Corps of Engineers, having jurisdiction over areas bordering Canada, participate in a number of engineering and control boards functioning under the International Joint Commission. (See summary report on these boards under sec. 1, "Policy Matters," above.) A detailed report on the various boards will be found in volume 2 under "Miscellaneous Civil Works, International Boundary Waters."

e. Flood plain studies. District Engineers began accepting applications from States and local governmental agencies for Flood Plain Information Studies under the authority of section 206 of the Flood Control Act of 1960 (Public Law 86–645). These studies make available data on flooding for guidance in planning and regulating the use of flood plains. Instructions for administering and executing the program were issued in EM 1165–2–111. Funds for initiating the studies will be available in fiscal year 1962.

CHAPTER IV

PROJECT CONSTRUCTION AND OPERATIONS PROGRESS

The Civil Works program of the Corps of Engineers, comprising navigation, flood control, and multi-purpose projects and various related activities, was diligently prosecuted during the fiscal year. Notable progress was made in carrying out project construction and placing additional works in useful operation. Construction was initiated on 53 new projects and on new features at 4 units of the Mississippi River flood control project. Also, construction operations were carried out on 147 additional projects and at additional units of the Mississippi River project. Fifty-five other projects, in addition to features at seven units of the Mississippi River flood control project and at four multiple-purpose projects, were placed in effective operation. A summary of project construction and operations by major classifications follows.

1. NAVIGATION PROJECTS

The present program for rivers and harbors as specifically authorized by Congress includes projects located throughout the United States, Puerto Rico, and the Virgin Islands. These projects are of various types: deep-draft harbors accomodating oceangoing vessels, shallow-draft channels for general small-boat navigation, inland and intracoastal waterways for commercial barge navigation, and the Great Lakes harbors and connecting waterways.

Construction. During fiscal year 1961, active construction operations were carried out on 108 navigation projects, of which 35 were placed in useful operation, as shown in table 1.

In fiscal year 1961, work was initiated on 29 navigation projects, as listed in table 2.

The 43 navigation projects having major construction activity underway at the close of the fiscal year, exclusive of the 29 new starts listed in table 2, are shown in table 3.

Operation and maintenance. Operation and maintenance activities were conducted on 292 navigation projects during the fiscal year at a cost of $88,846,055. In addition, costs of $2,227,323 were incurred on activities for the protection of navigation and surveys of northern and northwestern lakes. In allocating the funds being provided for project maintenance, every effort consistent with budgetary requirements is made to maintain navigation projects adequately to serve the reasonable requirements of commerce and navigation. This fiscal year, as in previous fiscal years, accomplishment of this work was confined principally to deep-draft harbors and major inland waterways, and for a relatively few channels serving areas where hardship to the locality would result from non-maintenance.

Rehabilitation. During fiscal year 1961, advance engineering and design activities were conducted on 18 major rehabilitation navigation projects at a cost of $477,273. Major structural rehabilitation was carried out at one navigation project at a cost of $189,058. Minor structural rehabilitation was actively prosecuted on 15 navigation projects at a cost of $1,436,670. Rehabilitation of three projects was completed by the end of the fiscal year.

Table 1. Navigation Improvements Placed in Useful Operation During Fiscal Year 1961

Project	Fiscal year started	Date placed in useful operation	Nature of improvement
Ashtabula Harbor, Ohio	1960	Jul 60	Extension river channel.
Barcelona Harbor, N.Y.	1958	Aug 60	Dredging and breakwater.
Bayfield Harbor, Wis.	1960	Aug 60	Small boat harbor.
Bellingham Harbor, Wash.	1961	Feb 61	Dredging.
Black Warrior, Warrior, and Tombigbee Rivers, Ala.	1957	Aug 60	Construction of Jackso Lock and Dam.
Boston Harbor (Reserved Channel), Mass.	1960	Aug 60	Dredging.
Cleveland Harbor, Ohio	1950	Apr 61	Dredging Cuyahoga River and replacement of railroad bridges.
Cohasset Harbor, Mass.	1960	Jul 60	Dredging.
Fort Madison, Iowa	1960	Jun 61	Small boat harbor.
Fort Myers Beach, Fla.	1961	Mar 61	Dredging.
Gastineau Channel, Alaska	1960	Jul 60	Do.
Gulf Intracoastal Waterway, Tex.: Realinement Vicinity Arkansas Pass.	1958	Oct 60	Dredging and highway bridge construction.
Halfmoon Bay Harbor, Calif.	1959	Jun 61	Breakwaters.
Herring Creek, Md.	1961	Nov 60	Dredging and jetties.
Houston Ship Channel, Turkey Bend Improvement	1961	Oct 60	Dredging.
Jamaica Bay, N.Y.	1961	Jun 61	Dredging (South interior channel and Mott Basin).
LaGrange Bayou, Fla.	1960	Jan 61	Dredging.
Little Pass, Clearwater Bay, Fla.	1961	Feb 61	Do.
Manasquam River, N.J.	1961	Jun 61	Do.
Manistique Harbor, Mich.	1960	Apr 61	Do.
Manteo (Shallowbag) Bay, N.C.—Oregon Inlet	1960	Aug 60	Do.
Matagorda Ship Channel, Texas Harbor of Refuge at Port Lavaca.	1959	Oct 60	Do.
Morehead City Harbor, N.C.	1960	Dec 60	Do.
Muscatine, Iowa	1960	May 61	Small boat harbor.
Naknek River, Alaska	1961	Oct 60	Boulder removal.
Nanticoke River, Md.	1960	Jul 60	Jetties.
New Cumberland Locks and Dam, Ohio River, Ohio	1955	Jun 61	Replacement for Locks and Dams 7, 8, and 9.
New York Harbor (channel along New Jersey Pierhead Line), N.Y.	1960	Nov 60	Dredging (widening at Northerly and Southerly Bends).
Pascagoula Harbor, Miss.	1960	Aug 60	Dredging.
Redwood City Harbor, Calif.	1960	Feb 61	Do.
Salem Harbor, Mass.	1959	Aug 60	Dredging and rock removal.
South Haven Harbor, Mich.	1961	Sep 60	Dredging.
Two Rivers Harbor, Wis.	1960	Jul 60	Do.
Weymouth-Fore River, Mass.	1958	Aug 60	Dredging and rock removal.
Whitefish Point Harbor, Mich.	1957	Sep 60	Dredging and breakwaters.

Table 2. Navigation Improvements Initiated During Fiscal Year 1961

Project	Date started	Scheduled fiscal year completion	Nature of improvement
Baltimore Harbor and Channel, Md	May 61	1966	Dredging.
Beaver Slough, Iowa	Jun 61	1962	Do.
Bridgeport Harbor, Conn	Mar 61	1962	Do.
Buttermilk Channel, N.Y	Aug 60	1962	Dredging and rock removal.
Crisfield Harbor, Md	May 61	1962	Dredging.
Davenport Harbor, Iowa	Mar 61	1962	Small boat harbor.
Dillingham Harbor, Alaska	Sep 60	1962	Dredging.
Dubuque Harbor, Iowa	Apr 61	1962	Do.
Freeport Harbor, Texas	Oct 60	1962	Do.
Grand Marais Harbor, Mich	Apr 61	1962	Breakwater extension.
Gulf Intracoastal Waterway, Texas, Colorado River.	Aug 60	1962	Dredging.
Homer Harbor, Alaska	Jun 61	1962	Small boat harbor.
Hood River, Oreg	Jun 61	1962	Small boat basin.
Houston Ship Channel (40′ project), Texas	Jan 61	1964	Dredging.
Kahului Harbor, Hawaii	May 61	1962	Do.
Lake St. Clair, Mich	Jun 61	1963	Do.
Maxwell Lock and Dam, Monongahela River, Pa	Dec 60	1965	Replacement for existing Locks and Dams 5 and 6.
New Poe Lock, St. Marys River, Mich	Dec 60	1966	Replacement of Poe Lock.
Opekiska Lock and Dam, Monongahela River, W. Va.	Jan 61	1966	Replacement for existing Locks and Dams 14 and 15.
Port Everglades Harbor, Fla	Mar 61	1965	Dredging.
Presque Isle Harbor, Mich	Jun 61	1962	Do.
Saginaw River, Mich	Oct 60	1964	Do.
Scarboro River, Maine	Jun 61	1962	Jetty.
Schuylkill River, Pa	Mar 61	1962	Rock removal (resumption).
Seldovia, Alaska	Jun 61	1963	Small boat harbor.
Seldovia, Alaska (channel work)	Jun 61	1962	Dredging.
Shilshole Bay, Wash	Jun 61	1962	Breakwater extension.
Straits of Mackinac, Mich	Jun 61	1963	Dredging.
York Harbor, Maine	May 61	1962	Do.

Table 3. Navigation Improvements Under Construction During Fiscal Year 1961

Project	Fiscal year started	Scheduled fiscal year completion	Nature of improvement
Apalachicola, Chattahoochee, and Flint Rivers, Ala., Ga., and Fla.	1959	1964	Construction of Columbia Lock and Dam.
Aquatic plant control	1959	1966	Control and eradication of obnoxious aquatic plant growths.
Arkansas River and Tributaries, Arkansas and Oklahoma.	1950	1970	Bank stabilization.
Barataria Bay W. W., La	1960	1962	Dredging.
Big Bay Harbor, Mich	1960	1962	Small boat harbor.
Buffalo Harbor (North Entrance Channel and Buffalo River), N.Y.	1959	1962	Dredging.
Calumet-Sag Modification, Ill., Waterway, Illinois and Indiana.	1956	1966	Channel improvements, bridges alterations and dredging.
Captain Anthony Meldahl Locks and Dam, Ohio River, Ky.	1958	1964	Replacement for existing Locks and Dams 31–34, inclusive.
Dam No. 27, Mississippi River, Ill	1959	1962	Canalization.
Delaware River, Philadelphia, Pa., to Trenton, N.J	1957	1963	Dredging and bridge reconstruction.
Detroit River, Mich	1957	1964	Dredging.
Galveston Harbor and Channel, Tex	1958	1962	Seawall construction.
Great Lakes to Hudson River Waterway, N.Y	1954	1966	Dredging, lowering sills on locks and guard gates, and raising bridges.
Greenup Locks and Dam, Ohio River, Ky	1955	1962	Replacement for existing Locks and Dams 27–30, inclusive.
Gulf Intracoastal Waterway, La.:			
1. Algiers Alternate Connection	1947	1962	Construction and dredging.
2. Port Allen Lock and Canal (Plaquemine-Morgan City Alternate Route).	1955	1965	Do.

Table 3. Navigation Improvements Under Construction During Fiscal Year 1961—Continued

Project	Fiscal year started	Scheduled fiscal year completion	Nature of improvement
Gulf Intracoastal Waterway, Tex.:			
Guadalupe River, Channel to Victoria	1958	1965	Dredging.
Channel to Port Mansfield	1960	1962	Dredging and jetty.
Honolulu Harbor, Hawaii (2d Entrance Channel)	1959	1962	Dredging and bridge construction.
Hudson River, N.Y.	1960	1967	Dredging and rock removal.
Inland Waterway, Delaware River to Chesapeake Bay, Del. and Md.	1957	1962	Summit bridge.
IWW, Caloosahatchee River to Anclote River, Fla.	1960	1965	Dredging.
Markland Locks and Dam, Ohio River, Ind.	1956	1962	Replacement for existing Locks and Dams 35–39, inclusive.
McAlpine Locks and Dam, Ohio River, Ky.	1957	1963	Reconstruction of Locks and Dam 41.
Mississippi River, Baton Rouge to Gulf of Mexico, La.	1960	1963	Dredging and construction.
Mississippi River-Gulf Outlet, La.	1958	1967	Do.
Mississippi River between Ohio and Missouri Rivers	1910	1968	Regulating works.
Missouri River, Kansas City to Mouth, Missouri	1912	1963	Bank stabilization.
Missouri River, Kansas City to Sioux City, Iowa	1928	1968	Do.
New York and New Jersey Channels, N.Y. and N.J.	1960	1962	Dredging and rock removal (widening in vicinity of B. and O. R.R. bridge).
Pike Island Locks and Dam, Ohio River, W. Va.	1959	1965	Replacement for existing Locks and Dams 10 and 11.
Playa Del Rey Inlet and Harbor, Calif.	1958	1962	Small boat harbor.
Port Aransas—Corpus Christi Waterway, Tex.	1957	1962	Dredging.
Port Hueneme Harbor, Calif.	1959	1962	Dredging and jetty construction.
Port St. Joe Harbor, Fla.	1959	1962	Dredging.
Rogue River Harbor, Gold Beach, Oreg.	1959	1962	Dredging and jetty construction.
Sabine-Neches Waterway, Tex.	1957	1964	Dredging.
Sacramento River Deep Water Ship Channel, Calif.	1950	1963	Dredging and construction.
St. Anthony Falls, Mississippi River, Minn.	1949	1963	Lock and dam construction and dredging.
St. Clair River, Mich.	1959	1965	Dredging and compensating works.
St. Marys River, Mich.	1958	1964	Dredging.
Savannah River below Augusta, Ga:			
Channel Cut-off	1959	1962	Do.
Dikes and Revetments	1959	1962	Construction of pile dikes and bank revetments.

2. BEACH EROSION CONTROL PROJECTS

The policy of Federal assistance in the construction of works for the restoration and protection against erosion by waves and currents applies to shores of the United States (including possessions) that are owned by States, municipalities, or other political subdivisions, and also to shores other than public if there is a benefit such as that arising from public use or from the protection of nearby public property or if the benefits to those shores are incidental to the project. Construction of a project is accomplished by local interests or by the Corps by mutual agreement. During fiscal year 1961, work was accomplished by the Corps at Imperial Beach and Oceanside, Calif., using advanced funds and other contributed funds. Other operations throughout the country were limited to payments to local interests for the Federal share in completed units of authorized projects.

3. FLOOD CONTROL PROJECTS (GENERAL)

Construction. During fiscal year 1961, active construction operations were carried out on 122 specifically authorized flood control projects, of which 20 were placed in useful operation, as shown in table 4, and an additional 11 were fully completed.

During the year, excluding multiple-purpose projects, work was initiated on 22 specifically authorized flood control projects, as shown in table 5.

The 80 flood control projects under active construction during the fiscal year, exclusive of multiple-purpose projects and those projects placed in useful operation or initiated during the year as shown in tables 4 and 5, are listed in table 6.

Construction operations were also carried out pursuant to the small-project authority contained in section 205 of the 1948 Flood Control Act, as amended by Public Law 685, 84th Congress. Thirteen small projects were placed in useful operation pursuant to this program, and 12 new projects were initiated during the year. In addition, design studies were carried out on 58 projects, and plans and specifications were under preparation for 14 projects which are expected to be initiated in fiscal year 1962.

Rehabilitation. During fiscal year 1961, minor rehabilitation was underway on three flood control reservoir projects at a cost of $29,674.

Table 4. Flood Control Projects Placed in Useful Operation During Fiscal Year 1961

Project	Fiscal year started	Month placed in useful operation	Nature of project
Adams, Mass	1950	Jun 61	Local protection.
Ball Mountain, Vt	1957	Jun 61	Reservoir.
Bear Creek, Pa	1956	Dec 60	Do.
Bradford, Pa	1955	May 61	Local protection.
Buckhorn, Ky	1957	May 61	Reservoir.
Clarksville, Ark	1961	Mar 61	Local protection.
Endicott, Johnson City, and Vestal, N.Y	1957	Oct 60	Do.
Malheur River, Vale Unit, Oreg	1960	Mar 61	Do.
Mansfield, Ind	1957	Oct 60	Reservoir.
Missouri River, Kenslers Bend, Nebraska to Sioux City, Iowa.	1946	Jun 61	Local protection.
North Adams, Mass	1950	May 61	Do.
North Hartland, Vt	1958	Dec 60	Reservoir.
North Springfield, Vt	1957	Sep 60	Do.
Red River of the North at Fargo, N. Dak	1959	Nov 60	Local protection.
Roseville, Ohio	1960	Oct 60	Do.
Salina, Kans	1957	Jun 61	Do.
Salt Lake City, Jordan River, Utah	1959	Oct 60	Do.
Success, Calif	1957	Oct 60	Reservoir.
Townshend, Vt	1957	Jun 61	Do.
West Hill, Mass	1959	Sep 60	Do.

Table 5. Flood Control Projects Initiated During Fiscal Year 1961

Project	Month started	Scheduled fiscal year completion	Nature of project
Bear Creek at Hannibal, Mo	Aug 60	1963	Local protection.
Brookville, Pa	Sep 60	1962	Do.
Council Grove, Kans	Jul 60	1965	Reservoir.
Drury Drainage District, Illionis	Jun 61	1963	Local protection.
East Rainelle, W. Va	Dec 60	1962	Do.
Floyd River, Sioux City, Iowa	Jun 61	1965	Do.
Hall Meadow Brook, Conn	Oct 60	1962	Reservoir.
Hunt and Lima Lake Drainage District, Illinois	Jul 60	1965	Local protection.
Mad River, Conn	Feb 61	1964	Reservoir.
Manhattan, Kans	May 61	do	Local protection
Milford, Kans	Jun 61	1966	Reservoir.
Millwood, Ark	Apr 61	do	Do.
Mississippi River at St. Paul Minn	Jun 61	1963	Local protection.
Monroe, Ind	Oct 60	1965	Reservoir.
Narragansett Bay (Fox Point), Rhode Island	Jan 61	1963	Hurricane protection.
Pantego Creek and Cucklers Creek, North Carolina	Jan 61	1962	Local protection.
Ridgway, Pa	Jun 61	1963	Do.
Salt Creek and Tributaries, Nebraska	May 61	1966	Do.
Shenango River, Pennsylvania and Ohio	Jul 60	1965	Reservoir.
Washington, Pa	May 61	1963	Local protection.
Wilkesboro, N.C	Sep 60	do	Reservoir.
Wilson, Kans	Apr 61	1965	Do.

Table 6. Flood Control Projects Under Construction During Fiscal Year 1961

Project	Fiscal year started	Scheduled fiscal year completion	Nature of project
Abiquiu, N. Mex	1956	1962	Reservoir and channel.
Allegheny River, Pa. and N.Y	1960	1965	Reservoir.
Allentown, Pa	1958	1961	Local protection.
Amite River and Tributaries, La	1957	1961	Do.
Battle Creek, Kalamazoo River, Mich	1957	1963	Do.
Beardstown, Ill	1954	1964	Do.
Bethlehem, Pa	1960	1963	Do.
Black Butte, Calif	1960	1963	Reservoir.
Buffalo Bayou, Tex. (Brays Bayou)	1956	1963	Local protection.
Canyon, Tex	1958	1964	Reservoir and channel.
Cape Girardeau, Mo	1956	1963	Local protection.
Carbon Canyon, Calif	1959	1961	Reservoir.
Carlyle, Ill	1958	1966	Reservoir and channel.
Central and Southern Florida	1950	After 1967	Local protection.
Clear Creek Drainage and Levee District, Illinois	1940	1964	Do.
Cooper Reservoir, Levees and Channels, Tex	1958	1964	Reservoir and channel.
Devil, East Twin, Warm, and Lytle Creeks, Calif	1956	1961	Local protection.
Dillon, Ohio	1946	1961	Reservoir and channel.
East Barre, Vt	1957	1962	Reservoir.
East Brimfield, Mass	1958	1961	Do.
East St. Louis and Vicinity, Illinois	1937	1963	Local protection.
Enid, Okla	1960	1961	Do.
Fabius River Drainage District, Missouri	1960	1961	Do.
Hopkinton-Everett, N.H	1959	1963	Reservoir.
Howard A. Hanson, Washington	1956	1962	Do.
Jackson Hole, Snake River, Wyo	1957	Indefinite	Local protection.
John Redmond, Kansas	1961	1965	Reservoir.
John W. Flannagan, Virginia	1960	1964	Do.
Kansas Citys, Kans. and Mo	1940	1963	Local protection.
Kettle Creek, Pa	1959	1961	Reservoir.
Keystone, Okla	1957	1965	Reservoir and channel.
Little Sioux River, Iowa	1956	1962	Local protection.
Los Angeles County Drainage Area, California	1935	1965	Do.
Lower Heart River, N. Dak	1958	1961	Do.
Lower San Joaquin River, Calif	1956	1964	Do.
McKinney Bayou and Barkman Creek, Tex. and Ark.	1960	1961	Do.
Middle Creek, Calif	1958	1961	Do.
Mississippi River at St. Louis, Mo	1959	1969	Do.
Missouri River Agricultural Levees, Iowa, Nebraska, Missouri.	1948	Indefinite	Do.
Muscatine Island Levee District and Muscatine-Louisa City Drainage District No. 13, Iowa.	1960	1962	Do.

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Table 6. Flood Control Projects Under Construction During Fiscal Year 1961—Continued

Project	Fiscal year started	Scheduled fiscal year completion	Nature of project
Navarro Mills, Tex	1960	1961	Reservoir.
New Hogan, Calif	1960	1961	Do.
Nolin, Ky	1959	1962	Reservoir and channel.
No. 2 Barren, Ky	1960	1964	Reservoir.
Oologah, Okla	1950	1962	Reservoir and channel.
Ottawa, Kans	1958	1962	Local protection.
Perry County Drainage and Levee Districts 1, 2, and 3, Missouri.	1937	1964	Do.
Pomme de Terre, Mo	1957	1962	Reservoir and channel.
Pomona, Kans	1959	1963	Do.
Princeton, W. Va	1960	1961	Local protection.
Proctor, Tex	1960	1965	Reservoir.
Prompton, Pa	1957	1961	Do.
Red River below Denison Dam, Texas and Louisiana	1948	1963	Local protection.
Red Rock, Iowa	1960	1966	Reservoir.
Rio Grande Floodway (Middle Valley-Cochiti to Rio Puerco Unit), N. Mex.	1960	1962	Local protection.
Roseville, Ohio	1960	1961	Do.
Sacramento River Flood Control Project, California	1918	1964	Do.
Sacramento River Major and Minor Tributaries, California.	1949	1967	Do.
San Antonio Channel Improvement, Texas	1957	After 1966	Do.
San Jacinto River Levee and Bautista Creek Channel, Calif.	1960	1961	Do.
San Lorenzo Creek, Calif	1959	1961	Do.
Santa Maria Valley Levees, Calif	1959	1961	Do.
Sioux Falls, S. Dak	1956	1961	Do.
Sny River Basin, Ill	1960	1964	Do.
Stillwater, Pa	1957	1961	Reservoir.
Summersville, W. Va	1960	1965	Do.
Sutton, W. Va	1950	1962	Do.
Terminus, Calif	1957	1962	Do.
Thomaston, Conn	1958	1961	Do.
Topeka, Kans	1937	1965	Local protection.
Truckee River, Calif. and Nev	1960	1961	Do.
Tuttle Creek, Kans	1952	1962	Reservoir and channel.
Two Rivers, N. Mex	1960	1963	Reservoir.
Waco, Tex	1958	1964	Reservoir and channel.
Westville, Mass	1960	1961	Reservoir.
Whitlow Ranch, Arizona	1959	1961	Do.
Willamette River Basin, Oregon	1938	1970	Local protection.
Wilson, Wenkel and Prairie du Pont Drainage and Levee District, Illinois	1939	1961	Do.
Wood River Drainage and Levee District, Illinois	1947	1962	Do.
Worcester Diversion, Massachusetts	1957	1962	Do.

Flood Control Reservoirs Operable June 30, 1961

Since enactment of the Flood Control Act of 1936, which established the Federal policy for that activity and assigned the responsibility for this nationwide program to the Corps of Engineers, there have been constructed 132 flood control dams and reservoirs in various river basins throughout the country. In addition, 17 reservoirs constructed by others have been assigned to the Corps for operation.

The flood control reservoirs constructed and operable are listed in table 2 in appendix C, together with information on the location, size, and characteristics of each project. A list of all multiple-purpose (power) projects in operation, many of which include reservoir capacity for flood control, also is set forth in table 1, appendix D. Detailed data on the flood control reservoirs and multiple-purpose projects listed in these tables are presented in volume 2 of the Annual Report.

4. MULTIPLE-PURPOSE PROJECTS INCLUDING POWER

The importance of multiple-purpose projects in relation to the overall activities of the Corps of Engineers continued to increase during the fiscal year as a result of the large construction program relating to these projects currently underway and the placing in operation of primary-purpose features at several projects. These projects have been designed to serve primarily in the interest of navigation or flood control and the production of hydroelectric power, although frequently other benefits, such as irrigation, pollution abatement, water supply, and recreation, are also realized.

The inclusion of power features in conjunction with other project features has often resulted in an enhancement of their economic value. Pertinent information on the power aspects of multiple-purpose projects is contained in a subsection below.

Construction. During the year, construction operations were carried out on 25 multiple-purpose projects.

Table 7. Multiple-Purpose Projects Completed for Full Beneficial Use During Fiscal Year 1961

Project	Fiscal year started	Scheduled fiscal year completion	Project primary purposes
Chief Joseph Dam, Columbia River, Wash.	1950	1961	Power.

During the year, two new multiple-purpose projects, Green Peter Reservoir, Oregon, and Lower Monumental Lock and Dam, Washington, were started.

Of the 25 multiple-purpose projects under active construction during the fiscal year, 8 projects had some or all primary features in useful operation at the end of the year. These projects are listed in table 8.

Table 8. Multiple-Purpose Projects Under Construction With Some or All Primary Project Features in Useful Operation During Fiscal Year 1961

Project	Fiscal year started	Scheduled fiscal year completion	Features placed in operation during fiscal year 1961	Project primary purposes
Table Rock Reservoir, White River, Mo.	1953	1961	Generator 3	Flood control* and power.*
Bull Shoals Reservoir, White River, Ark.	1947	1964		Do.
Cheatham Lock and Dam, Cumberland River, Tenn.	1951	1962	1-12,000 kw unit	Navigation* and power.*
Old Hickory Lock and Dam, Cumberland River, Tenn.	1953	1962		Do.
Fort Peck (2d powerplant).	1957	1963	Generators 4 and 5	Power.
Garrison Reservoir, Missouri River, N. Dak.	1946	1963		Flood control* and power.*
The Dalles Dam, Columbia River, Wash. and Oreg.	1953	1962	Generators 13 and 14	Navigation*, power* and irrigation*.
McNary Lock and Dam, Columbia River, Oreg. and Wash.	1947	1964		Navigation* and power.*

*Projects operated for these primary purposes at the beginning of and throughout fiscal year 1961.

Of the multiple-purpose projects under active construction at the end of the fiscal year, 16 projects had no primary-project features in operation. They are shown in table 9.

Operation and maintenance. Operation and maintenance activities were conducted on 34 multiple-purpose projects during the fiscal year at a cost of $19,851,285.

Table 9. Multiple-Purpose Projects Under Construction and Not Operating During Fiscal Year 1961

Project	Fiscal year started	Scheduled fiscal year completion	Project primary purposes
Hartwell Reservoir, Savannah River, Ga. and S.C.	1956	1963	Flood control, navigation, and power.
Walter F. George Lock and Dam, Chattahoochee River, Ga. and Ala.	1956	1963	Navigation and power.
McGee Bend Reservoir, Angelina River, Tex.	1957	1966	Flood control and power.
Eufaula Reservoir, Canadian River, Okla.	1957	1965	Do.
Beaver Reservoir, White River, Ark.	1960	1966	Power, flood control, and water supply.
Greers Ferry Reservoir, White River, Ark.	1957	1964	Flood control and power.
Dardanelle Lock and Dam, Arkansas River, Ark.	1957	1966	Navigation and power.
Barkley Dam, Cumberland River, Ky.	1957	1966	Flood control, navigation and power.
Oahe Reservoir, Missouri River, N. Dak. and S. Dak.	1949	1965	Flood control, navigation, power, and irrigation.
Big Bend Reservoir, Missouri River, S. Dak.	1959	1967	Power and flood control.
Cougar Reservoir, McKenzie River, Oreg.	1956	1964	Flood control, power navigation, and irrigation.
Hills Creek Reservoir, Willamette River, Oreg.	1956	1963	Do.
John Day Lock and Dam, Columbia River, Oreg. and Wash.	1958	1969	Do.
Ice Harbor Lock and Dam, Snake River, Wash.	1956	1962	Do.
Green Peter Reservoir, Middle Santiam River, Oreg.	1961	1967	Flood control, power, irrigation and navigation.
Lower Monumental Lock and Dam, Snake River, Wash.	1961	1968	Navigation and power.

Hydroelectric power production. The installation of hydroelectric power-generating facilities in Corps of Engineers multiple-purpose projects continues to progress as an important part of the Civil Works program. The installed capacity in commercial operation as of June 30, 1961, represented an increase of 4.5 percent over the capacity in operation on June 30, 1960. Electric energy production was 2 percent below the preceding fiscal year, due primarily to reduced loading scheduled by the marketing agency in the Pacific Northwest area.

As required by existing law, the Corps of Engineers delivers, with one exception, the electric power produced in excess of project requirements to the Department of the Interior for disposition at rates approved by the Federal Power Commission.

Installed capacity. Additional generation capacity of 298,000 kilowatts (nameplate rating) was placed in operation during the fiscal year and consisted of six generating units installed in four operating projects, as shown in table 10. This increase in generating capacity represents 17.2 percent of the hydroelectric capacity and 2.4 percent of the total generating capacity added to the Nation's utility systems during the fiscal year.

As of June 30, 1960, the Corps of Engineers had a total of 6,874,400 kilowatts of nameplate generating capacity in commercial operation at 32 projects, as listed in table 11. At the end of the fiscal year, the total generating capacity in operation at Corps of Engineers multiple-purpose projects represented 3.9 percent of the total generating capac-

ity and 20.5 percent of the hydroelectric generating capacity supplying the Nation's utility systems.

Hydroelectric power production. During the fiscal year, production of electric energy at Corps of Engineers multiple-purpose projects amounted to 27.2 billion kilowatt-hours, or 0.7 billion kilowatt-hours below the production in the preceding fiscal year. The power production for Corps of Engineers hydroelectric projects during fiscal year 1961 represents 3.6 percent of the total energy produced and 18.9 percent of the hydroelectric energy produced by the Nation's utility systems during the same period. Chart I illustrates the trend of power production for Corps of Engineers multiple-purpose projects with power for the past 10 fiscal years.

Additional capacity under construction. As of June 30, 1961, the Corps of Engineers has under construction 230,000 kilowatts of additional capacity at 2 operating projects and 4,251,000 kilowatts of capacity at 16 new projects, for a total of 4,481,000 kilowatts of generating capacity. This additional capacity is listed by projects in tables 11 and 12.

Projects in operation and under construction have a total ultimate capacity of 15,471,400 kilowatts, of which, under construction schedules at the beginning of fiscal year 1962, 7,380,400 kilowatts of capacity will be in operation by June 30, 1962. Chart II shows the continuing increase in installed capacity at Corps of Engineers projects for the past 6 fiscal years and the scheduled increases for fiscal years 1962 and 1963.

Table 10. Generating Capacity Placed in Service During Fiscal Year 1961

Projects	Size of units (kilowatts)	Number of units	Added capacity (kilowatts)
Cheatham	12,000	1	12,000
Fort Peck	40,000	2	80,000
Table Rock	50,000	1	50,000
The Dalles	78,000	2	156,000
Total		6	298,000

Table 11. Hydroelectric Projects in Operation June 30, 1961

Projects	Initial operation in fiscal year	Nameplate capacity—kilowatts		
		Existing installation	Under construction	Ultimate construction
Albeni Falls, Idaho	1955	42,600		42,600
Allatoona, Ga	1950	74,000		110,000
Blakely Mountain, Ark	1956	75,000		75,000
Bonneville, Oreg. and Wash	1938	518,400		518,400
Buford, Ga	1957	86,000		86,000
Bull Shoals, Ark. and Mo	1953	160,000	180,000	340,000
Center Hill, Tenn	1951	135,000		135,000
Cheatham, Tenn	1958	36,000		36,000
Chief Joseph, Wash	1956	1,024,000		1,728,000
Clark Hill, Ga. and S.C	1953	280,000		280,000
Dale Hollow, Tenn	1949	54,000		54,000
Denison, Okla. and Tex	1945	70,000		175,000
Detroit, Oreg	1954	118,000		118,000
Fort Gibson, Okla	1953	45,000		67,500
Fort Peck, Mont	1944	165,000		165,000
Fort Randall, S. Dak	1954	320,000		320,000
Garrison, N. Dak	1956	400,000		400,000
Gavins Point, Nebr. and S. Dak	1957	100,000		100,000
Jim Woodruff, Fla. and Ga	1957	30,000		30,000
John H. Kerr, N.C. and Va	1953	204,000		204,000
Lookout Point, Oreg	1955	135,000		135,000
McNary, Oreg. and Wash	1954	980,000		1,400,000
Narrows, Ark	1950	17,000		25,500
Norfork, Ark. and Mo	1944	70,000		140,000
Old Hickory, Tenn	1957	100,000		100,000
Philpott, Va	1954	14,000		14,000
St. Marys, Mich	1952	18,400		18,400
Table Rock, Ark. and Mo	1959	150,000	50,000	200,000
Tenkiller Ferry, Okla	1954	34,000		34,000
The Dalles, Oreg. and Wash	1957	1,119,000		1,743,000
Whitney, Tex	1954	30,000		30,000
Wolf Creek, Ky	1952	270,000		270,000
Total, projects in operation		6,874,400	230,000	9,094,400

Table 12. Hydroelectric Projects Under Construction June 30, 1961

Projects	Scheduled for operation in fiscal year	Nameplate capacity—kilowatts		
		Existing installation	Under construction	Ultimate installation
Barkley, Ky. and Tenn	1965		130,000	130,000
Beaver, Ark	1965		112,000	112,000
Big Bend, S. Dak	1965		468,000	468,000
Cougar, Oreg	1964		25,000	60,000
Dardanelle, Ark	1965		124,000	124,000
Eufaula, Okla	1965		90,000	90,000
Green Peter, Oreg	1966		110,000	110,000
Greers Ferry, Ark	1964		96,000	96,000
Hartwell, Ga. and S.C	1962		264,000	330,000
Hills Creek, Oreg	1962		30,000	30,000
Ice Harbor, Wash	1962		270,000	540,000
John Day, Oreg. and Wash	1967		1,350,000	2,700,000
Lower Monumental, Wash	1968		405,000	810,000
McGee Bend, Tex	1965		52,000	52,000
Oahe, N. Dak. and S. Dak	1963		595,000	595,000
Walter F. George, Ala. and Fla	1963		130,000	130,000
Total, projects under construction			4,251,000	6,377,000
Total, projects in operation (table 11)		6,874,400	230,000	9,094,40
Total		6,874,400	4,481,000	15,471,400
Total, projects in operation and under construction			11,355,400	

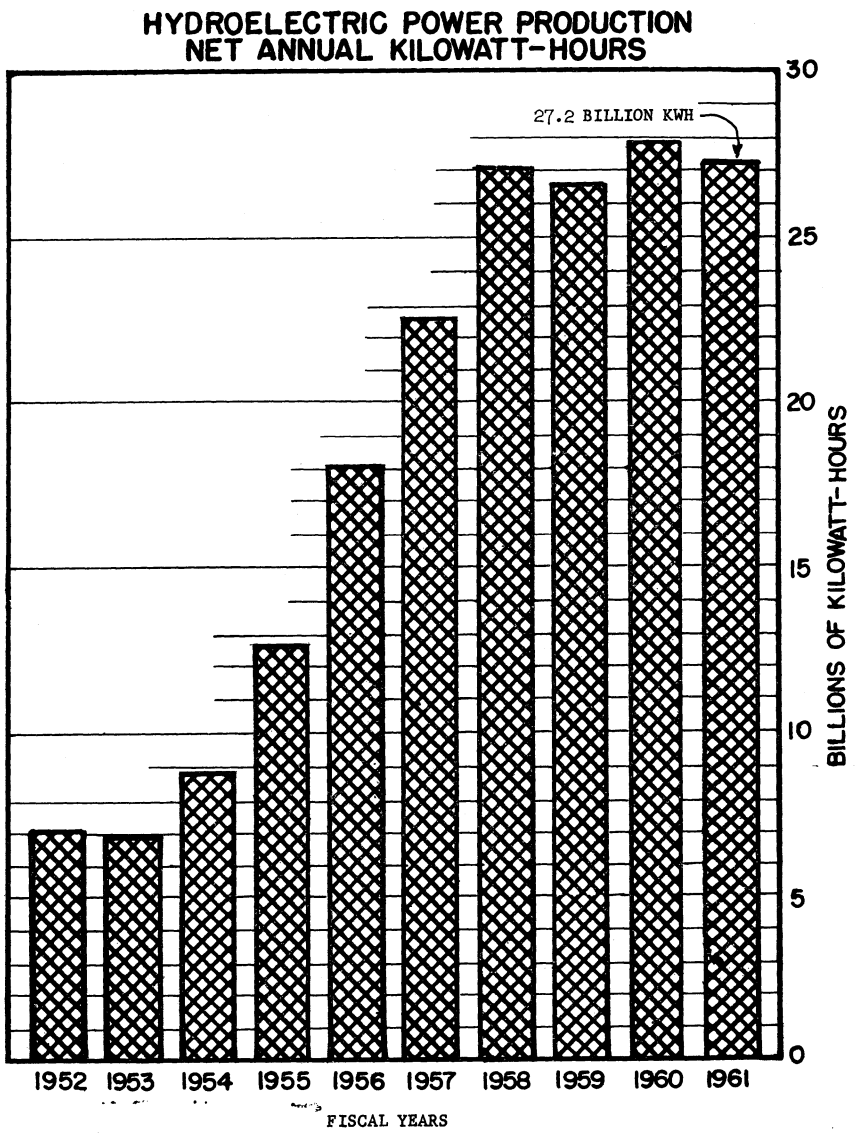
HYDROELECTRIC POWER PRODUCTION
NET ANNUAL KILOWATT-HOURS
27.2 BILLION KWH
30
25
20
15
10
5
0
BILLIONS OF KILOWATT-HOURS
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
FISCAL YEARS

CHART I

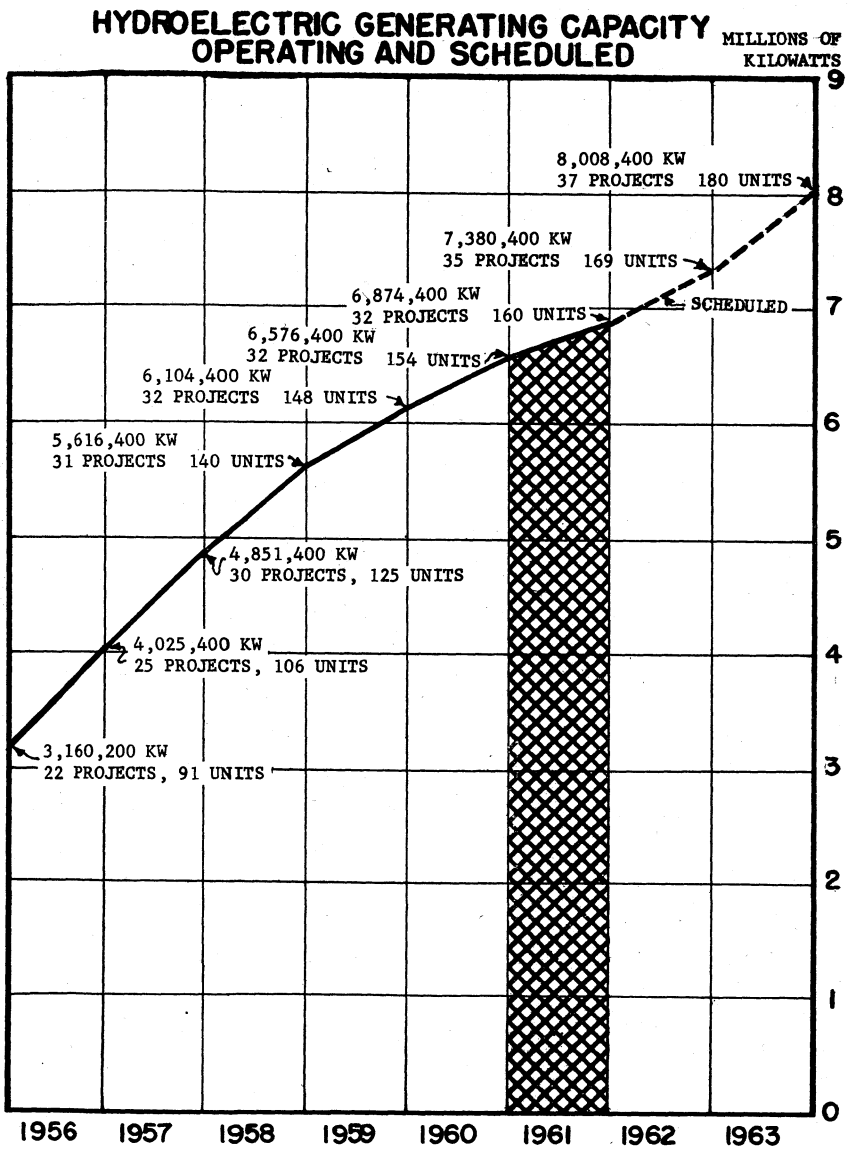
HYDROELECTRIC GENERATING CAPACITY
OPERATING AND SCHEDULED
MILLIONS OF KILOWATTS
8,008,400 KW
37 PROJECTS 180 UNITS
7,380,400 KW
35 PROJECTS 169 UNITS
6,874,400 KW
32 PROJECTS 160 UNITS
SCHEDULED
6,576,400 KW
32 PROJECTS 154 UNITS
6,104,400 KW
32 PROJECTS 148 UNITS
5,616,400 KW
31 PROJECTS 140 UNITS
4,851,400 KW
30 PROJECTS, 125 UNITS
4,025,400 KW
25 PROJECTS, 106 UNITS
3,160,200 KW
22 PROJECTS, 91 UNITS
9
8
7
6
5
4
3
2
1
0
1956
1957
1958
1959
1960
1961
1962
1963
FISCAL YEARS

CHART II

5. FLOOD CONTROL, MISSISSIPPI RIVER AND TRIBUTARIES

(Alluvial Valley)

The project for Mississippi River and tributaries, authorized by the Flood Control Act of May 15, 1928, and subsequent amendments, provides for flood protection of its alluvial valley below Cape Girardeau, Mo., from Mississippi River and local floods by means of levees and floodwalls, channel realinement and stabilization, reservoirs, floodways and outlets and drainage works. Authorizations through 1953 are described on pages 10 and 11 of part I, volume I, of the Annual Report of the Chief of Engineers for 1953. Amendments to the project in the Flood Control Acts, approved September 3, 1954, July 3, 1958, and July 14, 1960, are described in the Annual Reports of 1955, 1959, and 1961, respectively.

The total estimated cost of the work is $1,767,391,000, of which $1,448,877,100 is within the present monetary ceiling. At the end of the fiscal year, $1,162,665,652 had been appropriated and $1,156,176,000 had been expended.

Construction. During the year, the following construction features of seven units of the project were completed:

Table 13. Project Features Fully Completed During Fiscal Year 1961

Project unit	Date completed	Nature of project feature
Mississippi River at Old River control, La.	Feb 61	Inflow and outflow channels for low-sill structure.
Vicksburg Harbor, Miss.	Dec 60	Harbor channel, approach navigation channel and industrial fill.
Yazoo Basin, Miss.	Jul 60	Lower Auxiliary channel, leveed floodway and landside drainage ditches, mile 20.7 to mile 24.9.
	Jul 60	East bank levee enlargement—Techeva Creek.
	Oct 60	Lower Auxiliary channel—West levee drainage ditches.
	May 61	Quiver River channel improvement, mile 16.15 to mile 35.43 and 2 bridges in Leflore County.
	Dec 60	Bogue Hasty channel improvement, mile 0.0 to mile 6.5 and 4 bridges in Bolivar County.
	Dec 60	McKinney Bayou channel improvement, mile 2.18 to mile 5.74.
Yazoo River backwater area, Mississippi	Jul 60	Item 1, new levee.
Tensas Basin, La.	Nov 60	Bayou Macon, La., channel improvement, Reach 1.
St. Francis Basin, Ark. and Mo.	Sep 60	Madison-Marianna floodway channel and 4 bridges.
	Jun 61	2 Cross County bridges, Grassy Lake drainage channel.
	Oct 60	2 St. Francis County bridges, Round Pond drainage channel.

During the year there were no additional features of the project placed in useful operation.

During the year progress was made in the continuing construction of the principal features of the project on the main stem and on the tributaries in the alluvial valley. Main stem work on levees, revetments, dikes, and dredging was accomplished as follows: New main line levees constructed, 3.5 miles; main line levees enlarged to grade and section, 28.6 miles; secondary levees constructed, 9.7 miles; bank protection placed, 23.0 miles; dikes constructed, 4.0 miles; and

construction dredging, 6,659,000 cubic yards. At the end of the fiscal year, a total of 1,709 miles of main line levees containing 1,105 million cubic yards had been constructed, of which 1,559 miles containing 1,031 million cubic yards are located along the Mississippi River, and the remainder along major tributaries (lower Arkansas and Red Rivers) and outlets. Work was continued on the following additional project features:

Table 14. Project Features on Which Construction Was Continued During Fiscal Year 1961

Project unit	Nature of project feature
Mississippi River improvements	Levees, revetments, dikes, dredging, and wave wash protection.
Old River, La	Navigation lock and levees.
Memphis Harbor (Tennessee Chute), Tenn	Ensley levee.
Lake Pontchartrain, La	Levee enlargement, shaping, and wave wash protection.
Atchafalaya Basin, La	Levees, revetments, channel improvement by dredging, interior drainage, and highway and railway relocations.
Yazoo Basin, Miss	Lower Auxiliary channel—Humphreys County bridge and roads.
	Illinois Central RR. bridge.
Tensas Basin, La	Bayou Macon channel improvement—Reach 2.
Lower Arkansas River, Ark	North and south bank levee berms.
Lower White River, Ark	White River backwater levee system, enlargement of levee.
St. Francis Basin, Ark. and Mo	Floodways, levees, interior drainage, channels, highway and railroad crossings.
West Tennessee tributaries, Tennessee	Channel improvement.
Wolf River and tributaries, Tennessee	Do.

During the year, work was initiated on the following project features:

Table 15. Project Features on Which Construction Was Initiated During Fiscal Year 1961

Project unit	Date initiated	Nature of project feature
Mississippi River improvements	Nov 60	Mattress casting field at St. Francisville, La.
Greenville Harbor, Miss	Feb 61	Clearing, and first lift of retaining dikes.
Atchafalaya Basin, La	Oct 60	Wax Lake East Pumping Station—Interior drainage.
Yazoo Basin, Miss	Apr 61	East bank new levee, Piney Creek.
	Jun 61	West bank new levee, Belle Prairie to Wasp Lake.
	Jul 60	Lower Auxiliary channel, leveed floodway and landside drainage ditches, mile 24.9 to mile 30.9.
	May 61	Lower Auxiliary channel control weir.
	Nov 60	Big Sunflower River channel improvement, mile 99.0 to mile 169.5.
	May 61	Fighting Bayou channel improvement, mile 0.0 to mile 3.8.

During the year, preconstruction planning was continued on Mississippi River levee enlargement, bank protection, and on alluvial valley levees and channel improvements under construction. No preconstruction planning was initiated during the year.

Incident to the construction of the project, the following features were operated and maintained during the year:

Table 16. Project Features on Which Operation and Maintenance Activities Were Conducted During Fiscal Year 1961

Project unit	Nature of project features
Mississippi River	Channel improvement, levees, revetments, dikes, dredging, and wave wash protection.
Bonnet Carre Spillway, La	Levees, floodway, and control structure.
Atchafalaya Basin, La	Maintenance of levees and channels.
	Operation and maintenance:
	Locks:
	Bayou Sorrel.
	Bayou Boeuf.
	Berwick.
	Floodgates:
	Charenton.
	Calumet.
	Bayou Courtableau.
	Drainage structures: Wax Lake Outlet and numerous smaller drainage structures.
Morganza Floodway, La	Maintenance of floodway and control structure.
Lower Red River, La	Levees and bank protection works.
Tensas Basin, La	Bayou Cocodrie drainage structure.
Yazoo Basin, Miss.:	
Yazoo Basin headwater, Miss	Levees and channels.
Greenwood, Miss	Local protection—levees, storm water pumping station and drainage structures.
Yazoo City	Local protection—levees, storm water and sanitary sewage pumping stations, and drainage structures.
Sardis Reservoir	Reservoir
Arkabutla Reservoir	Do.
Enid Reservoir	Do.
Grenada Reservoir	Do.
St. Francis Basin, Mo.: Wappapello Reservoir	Reservoir.

Floods. Rains occurring over the upper Mississippi and Ohio River Basins in the spring resulted in the highest stages on the lower Mississippi River since 1950. Crest stages occurred in May at Cairo, Ill., Memphis, Tenn., Arkansas City, Ark., and Vicksburg, Miss., and ranged from 14.5 feet above flood stage at Cairo, Ill., to 2 feet below flood stage at Arkansas City, Ark. From Vicksburg, Miss., to Red River Landing, La., crest stages were approximately 2 feet above flood stage. At New Orleans, La., the crest stages were slightly below flood stage. Red River crested at Alexandria, La., at a stage of 29.4 feet, approximately 2.6 feet below flood stage. Crest stages occurred in the upper Ouachita River in April and May, and were 7 and 10 feet above flood stage at Arkadelphia, Ark., and Camden, Ark., respectively. It is estimated that the operation of Blakely Mountain Reservoir reduced the crest stage by about 6 feet and 5 feet at Arkadelphia and Camden, respectively. Locally heavy rains on Caddo River produced a peak stage of 27.95 feet at Glenwood, Ark., on May 6, 1961, which exceeded the previous maximum by about 1 foot. Crest stages occurred on the lower Ouachita River in May and were about 1 foot above flood stage at Monroe, La. Crest stages in the Boeuf-Tensas Basin were about 2.6 feet below bankfull in February–April.

The lower White River crested at Clarendon, Ark., in May at a stage of 31.0 feet, about 6.4 feet above flood stage, which was materially reduced by operation of upstream reservoirs.

The St. Francis River crested at St. Francis, Ark., in May at a stage of 21.6 feet, about 2.6 feet above flood stage. Operation of flood control works on the St. Francis River effected stage reductions above

Lake City, Ark., ranging from 1 to 4 feet. Crest stages occurred in March on the West Tennessee tributaries as follows: Obion River at Bogota, Tenn., 21.75 feet; North Fork of Forked Deer River at Dyersburg, Tenn., 23.2 feet; and Hatchie River at Rialto, Tenn., 15.4. These stages were 8.8 feet, 9.2 feet, and 3.4 feet, respectively, above flood stage. Wolf River crested in February at 14.5 feet at Raleigh, Tenn., about 2.5 feet above flood stage. Loosahatchie River crested in February at 22.8 feet at Brunswick, Tenn., about 1.3 feet above flood stages.

A moderate rise on the Coldwater-Tallahatchie-Yazoo Rivers began in February and crested in April at a stage 2.4 feet above flood stage at Swan Lake, Miss., and 1.6 feet below flood stage at Greenwood, Miss. The crest at Yazoo City, Miss., was 6 feet above flood stage. Operation of flood control works effected a reduction in stage averaging about 4.0 feet on the Coldwater River, 5.0 feet on the Tallahatchie River, and about 5.5 feet at Greenwood, Miss. Near record stages occurred on Big Sunflower River in February when the stage at Sunflower was 27.3 feet, about 2.3 feet above flood stage.

The lower Arkansas River crested at Pine Bluff, Ark., in May at a stage of 23.4 feet, about 0.6 foot below flood stage.

Condition of overall project. At the end of the fiscal year, construction on the project as a whole between Cape Girardeau, Mo., and the Gulf of Mexico was about 65 percent complete. Work on the main stem is sufficiently well advanced to afford a high degree of protection from Mississippi River flood overflow to most of the alluvial valley, except in unprotected backwater areas. A total of 1,510 miles of main line levees has been enlarged to project grade and section. The bank stabilization program has progressed steadily during recent years through construction of bank revetment, dikes, and corrective dredging, to prevent the river from regaining its former length due to its natural tendency to meander. A long-range plan is being developed to bring about and maintain the desired alinement of the river between Baton Rouge, La., and Cairo, Ill.

At the end of the fiscal year, there were 435 miles of operative revetment and 101,000 linear feet of effective dikes on the Mississippi River below Cairo, Ill. Channel protection work on the lower Arkansas River consists of 23.5 miles of revetment and 71,300 linear feet of dikes. Project work on lower Red River and Atchafalaya River consists of 5.2 miles of revetment and 16,000 linear feet of dikes. The Arkabutla, Sardis, Enid, and Grenada Reservoirs in the Yazoo Basin, Miss., and the Wappapello Reservoir in the St. Francis Basin, Mo., have been completed. Other authorized improvements in the alluvial valley, including levees, channel improvements, and supplementary drainage works, are under construction. A total of 1,206 miles of secondary levees, containing 384 million cubic yards, is in place. The Bonnet Carre, Morganza, West Atchafalaya, and Atchafalaya floodways are in a useful operational status and with the Atchafalaya River, will permit the diversion of 1,750,000 cubic feet per second of the project flood discharge to the Gulf of Mexico, leaving 1,250,000 cubic feet per second to pass down the main stem at New Orleans, La. Upon completion, the Old River control structure will prevent the steadily enlarging channels of the Old and Atchafalaya Rivers from capturing the flow of the Mississippi River. The total benefits that

have accrued since adoption of the project are estimated at more than $6 billion, which amounts to approximately $6 in benefits for every dollar of project funds so far expended.

The authorized Mississippi River and tributaries project, as amended, provides for a 12- by 300-foot navigation channel on the Mississippi River between Baton Rouge, La., and Cairo, Ill., and a 12- by 125-foot navigation channel on Old and Atchafalaya Rivers between the Mississippi River and Morgan City, La. The Mississippi River channel between Baton Rouge and Cairo was maintained to provide a dependable 9-foot depth for navigation, except at the following crossings: Commerce, Miss. (692 AHP), August 1–2, 1960, 8 feet, and Hatchie Towhead, Tenn. (774 AHP), October 16–17, 1961, 8.5 feet. Commensurably greater depths were available during the high water season. The Atchafalaya River channel through Grand and Six-Mile Lakes between the Mississippi River and Morgan City, La., was maintained to provide adequate depth throughout the year.

Comprehensive review of Mississippi River and tributaries project. The "Comprehensive Review of Mississippi River and Tributaries Project," dated December 18, 1959, was revised and resubmitted December 15, 1960.

Mississippi River reservoirs benefit study. The study to determine the benefits from upstream reservoirs in the relief of flood damage and the increase of low streamflow on the Mississippi River was completed in January 1961 and forwarded to the Chief of Engineers for review.

6. GENERAL OPERATIONS

Work done by contract. The Corps of Engineers for many years has consistently adhered to its policy of having construction work done by contractors wherever practicable. This past year was no exception to the policy. In fact, 97 percent of all construction work was performed by contract and only 3 percent by Government plant and hired labor. In recent years the amount of construction by hired labor has remained at this low percentage. A larger percentage of the operation and maintenance work has been performed by hired labor. The hired labor work on construction projects has been limited to such types of operations as dredging in exposed harbor entrances by Government-owned hopper dredge, the construction of erosion-control and levee-revetment works, and grouting operations. The nature of such work does not readily lend itself to advertising and performance by contract.

Accident prevention. Injury rates continued stabilized at a low level. Chart III shows comparison of injury rates for Corps of Engineers contractor employees with those for the construction industry. Also compared are injury rates for Corps of Engineers employees with those for all employees of the Federal Government.

Fire prevention. Government property and equipment losses by fire were $1,061,353, the highest ever recorded. This increase was due to two high loss incidents, one at the Waterways Experiment Station, Vicksburg, Miss., and the other at Bull Shoals powerhouse on the White River near Cotter, Ark.

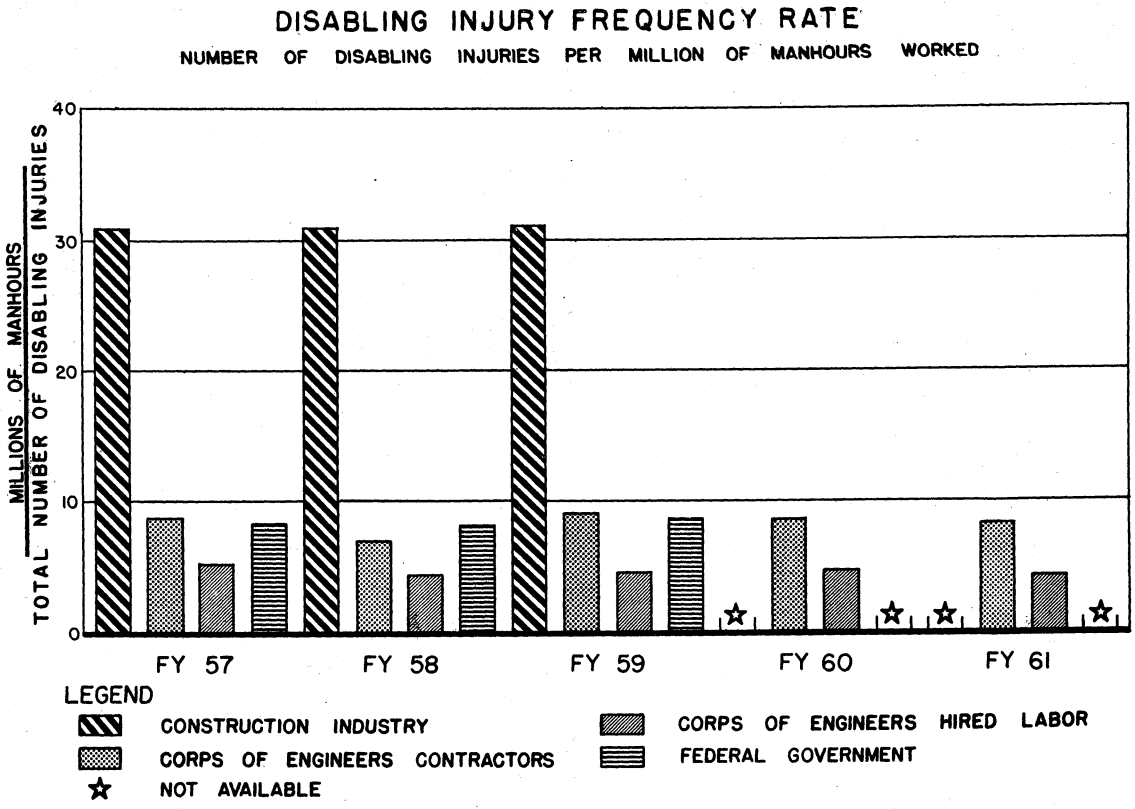
DISABLING INJURY FREQUENCY RATE
NUMBER OF DISABLING INJURIES PER MILLION OF MANHOURS WORKED
MILLIONS OF MANHOURS
TOTAL NUMBER OF DISABLING INJURIES
40
30
20
10
0
FY 57
FY 58
FY 59
FY 60
FY 61
LEGEND
CONSTRUCTION INDUSTRY
CORPS OF ENGINEERS CONTRACTORS
NOT AVAILABLE
CORPS OF ENGINEERS HIRED LABOR
FEDERAL GOVERNMENT

CHART III

CHAPTER V

FUNDING TRENDS

1. FUNDS AVAILABLE FOR WORK

Fiscal year 1961 funds appropriated for Civil Works activities of the Corps of Engineers amounted to $935,844,190. Individual appropriations are detailed in table 17. Status of the funds advanced by local interests for navigation and flood-control improvements is shown in table 18.

Table 17. Appropriations, Fiscal Year 1961

The funds with which the works for the maintenance and improvement of rivers and harbors and flood control were prosecuted during the fiscal year were derived from unexpended balances of prior appropriations and from the following appropriations acts, and by transfer from other departments:

Appropriation title	Date of act	Amount
PUBLIC WORKS APPROPRIATION ACT, 1961:	Sept. 2, 1960	
Flood Control, Mississippi River and Tributaries		$60, 896, 000. 00
General Investigations, Corps of Engineers, Civil		10, 223, 000. 00
Construction, General, Corps of Engineers, Civil		596, 491, 600. 00
Operation and Maintenance, General, Corps of Engineers, Civil		105, 420, 000. 00
General Expenses, Corps of Engineers, Civil, 1961		9, 870, 000. 00
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1961		25, 000. 00
International Navigation Congresses, Corps of Engineers, Civil, 1961 and 1962.		150, 000. 00
Total		783, 075, 600. 00
JOINT RESOLUTION:	July 2, 1960	
Flood Control, Mississippi River and Tributaries		11, 000, 000. 00
General Investigations, Corps of Engineers, Civil		1, 800, 000. 00
Construction, General, Corps of Engineers, Civil		110, 000, 000. 00
Operation and Maintenance, General, Corps of Engineers, Civil		21, 000, 000. 00
General Expenses, Corps of Engineers, Civil, 1961		2, 250, 000. 00
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1961.		5, 000. 00
Total		146, 055, 000. 00
THIRD SUPPLEMENTAL APPROPRIATION ACT, 1961:	Mar. 31, 1961	
Construction, General, Corps of Engineers, Civil		350, 000. 00
Operation and Maintenance, General, Corps of Engineers, Civil		3, 800, 000. 00
General Expenses, Corps of Engineers, Civil, 1961		780, 000. 00
Total		4, 930, 000. 00
SPECIAL FUNDS:	*Treasury Warrant No.*	
Hydraulic Mining in California, Debris Fund	579–96–3	18, 000. 00
Payments to States, Flood Control Act June 28, 1938, as Amended	842–96–6	1, 611, 812. 64
Maintenance and Operation of Dams and Other Improvements to Navigable Waters (Credits to Accounts from Licenses under Federal Water Power Act, Aug. 26, 1935).	824–96–5	153, 777. 30
Total		1, 783, 589. 94
TRUST FUNDS (CONTRIBUTIONS AND ADVANCES):		
Rivers and Harbors Contributed Funds	Various	13, 105, 329. 27
Rivers and Harbors Advanced Funds	do	272, 644. 00
Total		13, 377, 973. 27
RESTORATIONS:		
Salaries and Expenses, Office of Civil Defense Mobilization (Transfer to Corps of Engineers, Civil), 1958 and 1959.	Jun. 30, 1960	.02

Table 17. Appropriations, Fiscal Year 1961—Continued

Appropriation title	Date of act	Amount
FUNDS TRANSFERRED FROM OTHER DEPARTMENTS:		
Technical Cooperation, General, Executive (Transfer to Corps of Engineers, Civil).	Various	−$5,120.00
Technical Cooperation, General, Executive (Transfer to Corps of Engineers, Civil), 1959.	do	−25,205.58
Technical Cooperation, General, Executive (Transfer to Corps of Engineers, Civil), 1960.	do	10,315.56
Defense Support, General, Executive (Transfer to Corps of Engineers, Civil), 1959.	do	−21,676.01
Defense Support, General, Executive (Transfer to Corps of Engineers, Civil), 1960.	do	10,639.30
Construction and Rehabilitation, Bureau of Reclamation (Transfer to Corps of Engineers, Civil).	do	200,000.00
Construction, International Boundary and Water Commission, U.S. and Mexico, State (Transfer to Corps of Engineers, Civil).	do	200,000.00
U.S. Dollar Advances from Foreign Governments, U.S. Educational Exchange Program, State (Transfer to Corps of Engineers, Civil).	do	1,523.42
Capital Outlay, U.S. Soldiers' Home (Transfer to Corps of Engineers, Civil).	do	−187,000.00
Consolidated Working Fund, Army, Engineers, Civil	do	39,100.00
Total		222,576.69
Grand total, all funds		949,444,739.92

Table 18. Advanced Funds, Fiscal Year 1961

The following amounts have been advanced by local interests for river and harbor improvements under the provisions of Sec. II, River and Harbor Act, Mar. 3, 1925, and for flood control works under the provisions of the act of October 15, 1940 and are returnable to the same interests when necessary Government funds are available.

	District	Balance due from United States, June 30, 1960	Amount received during fiscal year	Amount returned during fiscal year	Balance due from United States, June 30, 1961
Selkirk—Shore Protection	Buffalo	$5,000.00		$408.38	$4,591.62
Imperial Beach, Calif.	Los Angeles	32,000.00	$20,644.00	5,820.65	46,823.35
Oceanside, Calif.	do		252,000.00		252,000.00
Total rivers and harbors		37,000.00	272,644.00	6,229.03	303,414.97

2. ANNUAL APPROPRIATIONS

Chart IV indicates the fluctuation in annual appropriations since 1951 for Civil Works functions.

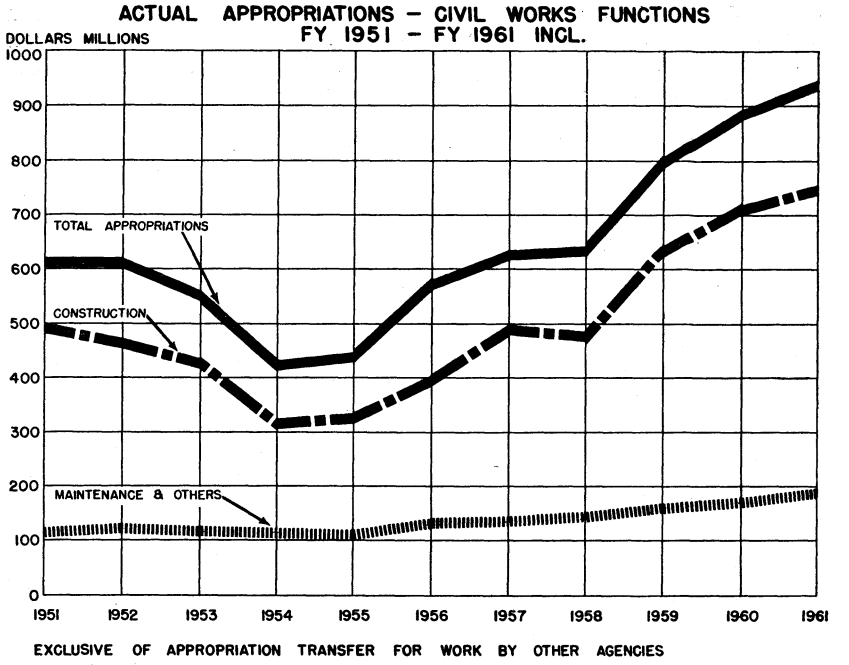

CHART IV

3. EXPENDITURES (COSTS)

During fiscal year 1961, expenditures (costs) amounted to $935,962,404 on the Civil Works program. Of this amount, $751,153,571 was for construction and $184,808,833 for all other activities except those funded by contingencies, advances, and collections from local sources and transfers from other agencies. Chart V shows comparative expenditure (cost) data since 1954. Expenditures under each appropriation are listed in table 19.

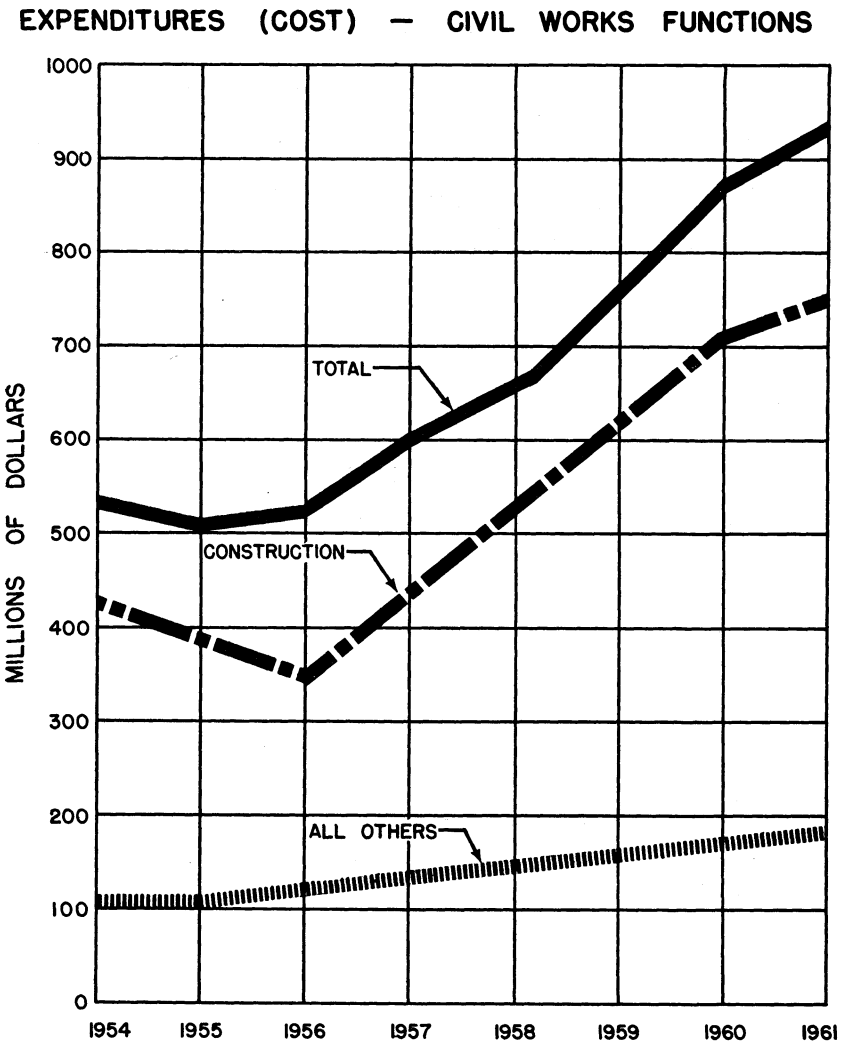

CHART V

Table 19. Accrued Expenditures, Fiscal Year 1961

The total actually expended under the direction of the Chief of Engineers in connection with the maintenance and improvement of rivers and harbors, flood control, and other miscellaneous works during the fiscal year ended June 30, 1961 as follows:

Appropriation title	Amount
RIVERS AND HARBORS AND FLOOD CONTROL:	
Flood Control, Mississippi River and Tributaries	$70,822,949.70
General Investigations, Corps of Engineers, Civil	11,824,588.75
Construction, General, Corps of Engineers, Civil	709,298,720.19
Operation and Maintenance, General, Corps of Engineers, Civil	129,462,988.75
General Expenses, Corps of Engineers, Civil, Prior Years	−18.19
General Expenses, Corps of Engineers, Civil, 1958 and 1959	957.78
General Expenses, Corps of Engineers, Civil, 1960	62,195.49
General Expenses, Corps of Engineers, Civil, 1961	12,796,525.93
Maintenance and Operation of Dams and Other Improvements to Navigable waters	153,777.30
Total Rivers and Harbors and Flood Control	934,422,685.70
MISCELLANEOUS APPROPRIATIONS:	
Niagara Remedial Works	7,482.04
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1960	238.53
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1961	3,215.64
International Navigation Congresses, Corps of Engineers, Civil, 1961 and 1962	15,688.20
Hydraulic Mining in California, Civil	20,938.17
Payments to States, Flood Control Act June 28, 1938, as Amended	1,492,155.55
Total Miscellaneous Appropriations	1,539,718.13
CONTRIBUTED AND ADVANCED FUNDS:	
Rivers and Harbors Contributed Funds	10,292,254.23
Rivers and Harbors Advanced Funds	69,761.83
Total Contributed and Advanced Funds	10,362,016.06
Total Appropriated and Contributed Funds	946,324,419.89
TRANSFERS FROM OTHER DEPARTMENTS:	
Disaster Relief, Executive Office of the President (Transfer to Corps of Engineers, Civil)	31,390.00
Technical Cooperation, General, Executive (Transfer to Corps of Engineers, Civil), 1960	12,390.48
Defense Support, General, Executive (Transfer to Corps of Engineers, Civil), 1959	−4,885.00
Defense Support, General, Executive (Transfer to Corps of Engineers, Civil), 1960	10,639.30
Construction and Rehabilitation, Bureau of Reclamation (Transfer to Corps of Engineers, Civil)	471,069.33
Construction, Bureau of Indian Affairs (Transfer to Corps of Engineers, Civil)	333,757.63
Construction, International Boundary and Water Commission, U.S. and Mexico, State (Transfer to Corps of Engineers, Civil)	60,344.46
Passamaquoddy Tidal Power Survey (Transfer to Corps of Engineers, Civil)	26,719.38
Salaries and Expenses, National Science Foundation (Transfer to Corps of Engineers, Civil)	875.66
U.S. Dollar Advances from Foreign Governments, U.S. Educational Exchange Program, State (Transfer to Corps of Engineers, Civil)	1,969.36
Capital Outlay, U.S. Soldiers' Home (Transfer to Corps of Engineers, Civil)	1,645,687.16
Capital Outlay, U.S. Soldiers' Home (Transfer to Corps of Engineers, Civil), 1959 and 1960	24,463.50
Consolidated Working Fund, Army, Engineers, Civil	5,437.63
Total Transfers from Other Departments	2,619,858.89
WORKING FUNDS:	
Consolidated Working Fund, Army, Engineers, Civil (Trust Fund)	48.28
Grand total, all funds	948,944,327.06

CHAPTER VI

OTHER CIVIL WORKS ACTIVITIES

1. ST. LAWRENCE SEAWAY

By letter dated September 17, 1954, addressed to the Secretary of the Army, the St. Lawrence Seaway Development Corporation designated the Corps of Engineers as its agent for design and construction of the seaway project. The Corporation was created on May 13, 1954, under authority of Public Law 358, 83d Congress, 2d session.

The project involves construction of navigation facilities in U.S. waters in the reach of the St. Lawrence River which constitutes the boundary between the United States and Canada, and coordination thereof with the power facilities to be constructed concurrently by others.

The major features of the project are complete. All completed features have been transferred to the St. Lawrence Seaway Development Corporation for operation. The contracting authority of the Corps of Engineers was terminated on December 31, 1958, and all cost and fiscal responsibilities were assumed by the Seaway Corporation on January 1, 1959.

Dredging in sections B and E in the South Cornwall Channel by hired labor and the U.S. dipper dredges *Gaillard* and *Paraiso* was completed on November 4, 1960. This terminated the Corps of Engineers activities for the St. Lawrence Seaway Development Corporation.

For detailed report on the St. Lawrence Seaway, see volume 2, Buffalo District.

2. ST. LAWRENCE RIVER JOINT BOARD OF ENGINEERS

This Board, having United States and Canadian Sections, was created pursuant to the order of approval issued by the International Joint Commission on October 29, 1952. The U.S. Section was established and its duties defined by an Executive order issued November 4, 1953. Members of the U.S. Section are the Secretary of the Army and the Chairman of the Federal Power Commission, with Maj. Gen. C. G. Holle (Ret.) (retained on a consultant basis) and Mr. F. L. Adams, Chief of the Bureau of Power of the Federal Power Commission, as alternates.

The duties of the Board are to review and approve, in behalf of both Federal Governments, the plans, specifications, and work schedules for the power project in the International Rapids section of the St. Lawrence River, and to inspect construction operations to insure conformance with Board approvals. The power project is being constructed jointly by the Power Authority of the State of New York and The Hydro-Electric Power Commission of Ontario. Supervision of construction pursuant to the Federal Power Commission license issued July 15, 1953, to the Power Authority of the State of

New York, also was assigned to the U.S. Section, thus integrating these two Federal supervisory activities.

A small engineering staff to support the U.S. Section was established in Massena, N.Y., on July 1, 1954, with Washington liaison. In consideration of the advanced stage of construction of the power project, the Massena office was closed on August 8, 1958, with staff support thereafter being provided in the Office of the Chief of Engineers and the Washington office of the Federal Power Commission.

Costs of the U.S. Section through June 30, 1961, totaled about $438,000. An additional $20,000 was appropriated to finance the activities of the U.S. Section during fiscal year 1962. All costs of the U.S. Section are subject to reimbursement by the Power Authority of the State of New York, as provided in the appropriation acts.

3. FLOOD-FIGHTING AND OTHER EMERGENCY OPERATIONS

Emergency flood-control activities, involving advance preparation for flood emergencies, flood rescue work, flood fighting, and the repair and restoration of flood control works damaged or destroyed by flood, were carried on during the year under statutory authority set forth in Public Law 99, 84th Congress, and prior legislation. The fiscal year expenditures from the emergency fund totaled $5,612,297. The most noteworthy flood emergencies and emergency operations during the fiscal year are described in the following paragraphs.

October 1960 floods in Texas. Torrential rains caused flash flooding on the Navidad, Lavaca, Guadalupe, Mission, and Nueces Rivers in southwest Texas. Flood fighting assistance was furnished at Victoria, on the Guadalupe River.

February 1961 floods, Washington and Oregon. Heavy rains and snowmelt caused severe flooding in Washington, and flood-fighting assistance was furnished. There were also record flood flows on Willamette River tributaries, near Eugene, Oreg.

February-March 1961 floods in Georgia, Alabama, and Mississippi. Persistent heavy rains resulted in widespread severe flooding with nearly 10,000 persons evacuated from low areas during the peak flows, which reached record stages at several points. Major floods occurred in the Pearl, Leaf-Chickasawhay-Pascagoula, Tombigbee-Warrior, Alabama-Coosa, and Chattahoochee-Flint-Apalachicola River Basins. Under Public Law 875, 81st Congress, the President issued a "major disaster" declaration regarding the adversely affected areas of Alabama, Mississippi, and Georgia. The Corps assisted in flood rescue work on the Alabama River and undertook emergency repairs of flood-damaged levees in the Yazoo River Basin, under the authority of Public Law 99.

March 1961 floods in Iowa. As a result of concurrent snowmelt and rainfall, record or near-record stages were reached on the Shellrock and Cedar Rivers in the Cedar River Basin. Damage in the Cedar River Basin was estimated to exceed $150 million, with the greatest losses in the Waterloo-Cedar Falls area. The President issued a "major disaster" declaration under Public Law 875 regarding these adversely affected areas.

May 1961 floods in Kansas, Oklahoma, Illinois, and Indiana. Unusually severe flooding occurred along the Soloman, Saline, Marais

des Cygnes, Arkansas, Grand, and Verdigris Rivers in Kansas and Oklahoma. Damages of about $6 million were prevented by existing reservoirs in the Tulsa District. There were major floods in Illinois and Indiana, with near-record stages in the Wabash River Basin, and the affected areas were declared by the President under Public Law 875 to be a "major disaster" area. Over 1,420,000 acres were affected in these two States, and damages sustained were estimated at roughly $23 million, while damages prevented by agricultural levees and local protection projects were estimated as over $7 million.

May 1961 floods in Idaho. The maximum flood stage of record occurred on the Kootenai River at Bonners Ferry, Idaho. A major flood fight initiated at local request resulted in preventing flooding in the town of Bonners Ferry and on almost 80 percent of the leveed land. Cost of the flood-fighting assistance by the Corps of Engineers under Public Law 99 authority was about $1.2 million, and the estimated cost of emergency levee repairs about $1 million.

4. ADMINISTRATION OF LAWS FOR PROTECTION OF NAVIGABLE WATERS

In administering the Federal laws enacted for the protection and preservation of the navigable waters of the United States, 6,510 permits for structures or operations in navigable waters were issued and plans for 126 bridges, dams, dikes, or causeways were approved during the year. In addition, 36 extensions of time for commencement or completion of construction of bridges were granted. Sixty-nine sets of regulations for the use, administration, and navigation of navigable waters were established, including drawbridge regulations, establishment of anchorage grounds, special anchorage areas, dumping grounds, danger zones, and restricted areas.

The Corps of Engineers engaged in the following additional activities relative to the administration of the laws for the protection of navigable waters: Investigations of the discharge or deposit of refuse matter of any kind in navigable waters; prevention of pollution of coastal navigable waters by oil; administrative determination of the heads of navigation and the extent to which the laws shall apply to specific streams; supervision of the harbors of New York (including the waters of Long Island Sound), Hampton Roads and Baltimore to prevent obstructive and injurious deposits in the waters thereof; establishment of reasonable rates of toll for transit across bridges over navigable waters; granting of permits for the occupation and use of Federal works under control of the Corps of Engineers; reports of international boards on operations affecting international boundary waters; and legislation in connection with the foregoing.

There is a continuing program to prevent deposits or to obtain the removal of any deposits in channels which obstruct navigation or increase Federal maintenance costs. In all areas of the country, most industries and municipalities are removing, or are participating in the cost of removal of shoals for which they are responsible. All waterways are being observed and negotiations commenced with any company or municipality which may be causing shoaling due to waste deposits. During the past few years agreements have been entered into between the Government and industrial plants whereby the plants

undertook remedial dredging providing for savings to the United States averaging approximately $1 million per year. The program has resulted not only in a saving in dredging costs and more efficient use of dredging equipment, but also in a stimulation of planning by the industries to improve their operations for recovering salvageable material. In the case of one company, which declined to accept responsibility for its deposits in the Calumet River, Ill., court action was instituted in 1954. Decree was entered on June 24, 1957, by the district court in favor of the United States. The defendant was ordered to stop the deposit of materials and to remove the accumulation within 6 months. The defendant appealed the case and on January 22, 1959, the court of appeals reversed the district court. On June 1, 1959, the Supreme Court agreed to review the case, and on May 16, 1960, reversed the judgment of the appeal court and remanded the case to the court of appeals. On February 17, 1961, the court of appeals rendered its decision. A new trial was ordered.

A report entitled "Navigational Clearance Requirements for Highway and Railroad Bridges" prepared by the U.S. Department of Commerce was released in 1955. The conflicting interests involved are the desire of navigation interests for the maximum navigation opening and the desire of bridge owners to conserve funds by building a minimum crossing. In connection with its continuing studies of the problems involved at intersections of highway and water traffic, the Corps of Engineers is making a thorough review of its policy on bridge clearances with a view to resolving problems involved in meeting the requirements of both water and land transportation interests. The present system of standard bridge clearances is being reviewed and extended to cover, insofar as practicable and necessary, all navigable waterways. During fiscal year 1961, review of the standard bridge clearances for the Missouri River, the upper Mississippi River, and the Sacramento River was continued.

The procedure whereby a "finding of fact" is prepared for attachment to the formal approval of bridge plans was continued. When necessary or in controversial cases, an economic analysis to assist in determination of the clearance requirements for a bridge may be developed.

Toward the end of fiscal year 1956, the Secretary of the Army gave his advance approval to the location and plans of bridges across reaches of waterways navigable in law but not actually navigated other than by logs, log rafts, rowboats, canoes, or small motorboats. A procedure for administering this advance approval and delineating these proposed reaches was established.

Under the Bridge Alteration Act (Truman-Hobbs) approved on June 21, 1940, as amended by the act of July 16, 1952, the cost of altering a bridge used for railroad traffic, combined railroad and highway traffic or a publicly owned highway bridge, found by the Secretary of the Army to be obstructive to navigation, is apportioned between the bridge owner and the United States. Hearings in connection with obstructive qualities are held to determine if the bridge is an unreasonable obstruction to navigation. During fiscal year 1961, no hearings were held on obstructive bridges. Funds have been made available for continuation of alteration on three bridges. Action was

continued on four additional obstructive bridge cases in various stages of development.

The removal of wrecks in navigable waters of the United States is governed by sections 19 and 20 of the River and Harbor Act approved March 3, 1899, and is predicated entirely upon their being obstructions to navigation. During the fiscal year, 47 wrecks were removed by the Corps of Engineers as obstructions to navigation.

5. REGULATION OF HYDRAULIC MINING, CALIFORNIA

The California Debris Commission, created by act of Congress, regulates hydraulic mining in the drainage area of the Sacramento and San Joaquin Rivers to prevent the resulting debris from being carried into navigable waters. The Commission has licensed 13 mining operators, of which 2 utilize storage behind the Federal debris dams.

During the year the Harry L. Englebright Dam and the North Fork Dam, together with their appurtenant service facilities, were operated and maintained for the storage of hydraulic mining debris.

In addition, hired labor was utilized to construct improvements to existing recreation areas as follows: Englebright Dam, parking areas; and North Fork Dam, access road, parking areas, and boat-launching ramp.

Work accomplished on the Yuba River, by contract, consisted of: (1) Repairs to Daguerre Point Dam; and (2) bank restoration and stone protection, right bank, Yuba River, vicinity of Simpson Lane and Hallwood Road, in Yuba County. The cost of this activity is paid in part from funds provided from receipts of required contributed funds.

6. CIVIL WORKS INVESTIGATION PROGRAM

Under the Civil Works investigation program, a total of 82 research projects were conducted during the fiscal year, leading to the establishment of more reliable engineering design data, utilization of superior or less costly construction materials, and improvements in construction and maintenance procedures. The total program cost was $1,188,740 during fiscal year 1961, of which approximately 73 percent was expended by the U.S. Army Engineer Waterways Experiment Station, slightly over 6 percent by the Beach Erosion Board, and the balance by Corps Divisions and Districts.

Three of the 82 projects were new investigational studies relating to (*a*) the effect of compaction methods and age on the strength and stress-strain characteristics of soils, (*b*) the use of a vane shear device for making in-place measurements of shear strength of soils in the field, and (*c*) a review and revision to a 1953 report on stream bank protection methods to incorporate engineering data and experience accumulated during the past several years.

Six investigations were completed, as follows:

CW 314—Design, development, and engineering tests leading to more efficient hopper dredge pumps and impellers. (Philadelphia District)

CW 518—Studies and tests to determine the effect of partial saturation on hydrostatic pore pressures in and shear strengths of soils under various loads. (USAEWES)

CW 521(B)—Studies and tests of the influence of gradation and maximum particle size on the shear characteristics of compacted coarse-grained soils. (SPD Lab)

CW 808—Investigation of the hydraulic phenomena related to the intermixing of liquids of different densities (including salt water and fresh water) under natural flow conditions, in lock structures, and resulting from wind forces. (USAEWES)

CW 814—Model and prototype tests of towing resistances of different barge configurations and arrangements, and under various conditions of channel width, depth and side slopes. (Pittsburgh District)

CW 845—Development of design methods for calculating the magnitude and characteristics of tides and tidal currents in canals and estuaries. (USAEWES)

In addition to these 6 completed projects, 19 substudies under other continuing investigations were completed during fiscal year 1961, and 36 documents were published presenting significant results for interim use within the Corps prior to formal completion of the entire investigation.

7. U.S. LAKE SURVEY

The U.S. Lake Survey, under its authorized project, continued the program of preparing, revising, and distributing navigation charts of the Great Lakes and their outflow rivers, the New York Canal system, Lake Champlain, and the Minnesota-Ontario border lakes; and the study of all matters affecting the hydraulics and hydrology of the Great Lakes system. The Great Lakes Pilot and seven monthly supplements thereto were compiled and issued to complement the navigation information on the charts. An alltime record for sales for 1 month occurred in July 1960 when 21,257 charts were sold.

Completion of the offshore soundings in Lake Ontario in the fall of 1960 brought to an end the fieldwork in connection with the 8-year program of deep-water sounding on all of the Great Lakes to supplement former soundings and give adequate coverage using modern methods and electronic positioning equipment to meet the needs of changing conditions and the increased use of the Great Lakes waterways for navigation. Sounding lines now extend across each of the Great Lakes, spaced no more than 1½ miles apart and cover the entire 95,000 square miles of water surface in this area.

In addition to the completion of the offshore sounding program, special underwater sweeping operations to locate obstructions to navigation were made at Manistee, Mich., in the approaches to the new harbor at Port Dolomite, Mich., and in the south end of Lake Huron.

Inshore sounding of Lake Ontario, which was started in 1959, was continued during July and August.

The tellurometer, an electronic distance-measuring device, was used to establish horizontal control on Lake St. Clair and the west

end of Lake Erie for use in locating detailed inshore sounding operations in these areas, and the hydrographic surveys were started. Aerial photographs of the St. Clair-Detroit River system were obtained in connection with the above work to assist in the production of large-scale small-boat charts of this area.

Revisory surveys were completed on the Minnesota-Ontario border lakes; at selected harbors on Lakes Superior, Huron, St. Clair, and Erie; and on the St. Clair and Detroit Rivers.

First-order levels were run from Lake Huron to Lake Superior along the St. Marys River; along the Fox River from Green Bay to De Pere; and at selected harbors on Lakes Superior and Michigan.

Discharge measurements were made in the main channel of the Detroit River and in each of the many channels in the lower section of the river. Reduction of these discharge measurements was started.

In addition, much data of a hydraulic and hydrologic nature were collected, reduced, tabulated, and disseminated. Engineering and scientific analyses were made of these data for the benefit of navigation; other Corps of Engineers activities; and other public commercial and industrial interests. Consulting engineer services were furnished to Corps of Engineers organizations, and to the various international commissions, boards, and committees concerned with the Great Lakes and their outflow rivers, including the St. Lawrence River. Data pertaining to Great Lakes hydraulics and hydrology, which are published regularly by the U.S. Lake Survey, include monthly bulletins of Great Lakes levels, a hydrograph of monthly mean levels of the individual Great Lakes, tabulations of precipitation on the lake basins; diversions of water into, between, and from the lakes; flows in the connecting rivers; and 6-month forecasts of the lake levels.

8. WASHINGTON, D.C., WATER SUPPLY

With funds appropriated for the District of Columbia, the Corps of Engineers continued the operation, maintenance, repair, and protection of the water-supply facilities, known as the Washington Aqueduct, to provide an uninterrupted and adequate supply of purified water to the distribution systems of the District of Columbia and adjacent Maryland and Virginia areas as authorized by law. The maximum daily consumption provided by the existing facilities was 230 million gallons and the average daily consumption was 163 million gallons.

During the fiscal year, an accelerated program for deep cleaning the slow-sand filters was initiated at the McMillan Filtration Plant in order to restore the filters to a more dependable capacity. Eight of the 29 filter beds have been deep cleaned during the year and it is planned to continue this program until all filters have been restored to provide a sustained rate sufficient to meet the requirements of the system.

In order to meet the future demands for water, construction work continued on the long-range program. Construction of the new Dalecarlia filter and chemical buildings was begun in July and the work is scheduled to be completed in the spring of 1963. During the past year, new circulating facilities were installed in the 2d High Reservoir

by Washington Aqueduct forces. A draft of the design memorandum for the Flocculation-Sedimentation Basin No. 3 is completed and the final report will be submitted early in fiscal year 1962. Additional funds for this construction will be requested in fiscal year 1963. Engineering studies for remodeling the raw water intakes at the Great Falls Intake are now in progress. Designs for the relocation of the 78-inch Penstock line and the 24-inch Arlington pipeline were continued during the year, and this program is scheduled to begin upon completion of the construction of the new Dalecarlia filter and chemical buildings.

For detailed report on Washington, D.C., Water Supply, see volume 2, Washington, D.C., District.

9. FOREIGN TECHNICAL ASSISTANCE

The Corps of Engineers continued to participate in the foreign technical assistance program of the Department of State and the Agency for International Development (AID), formerly the International Cooperation Administration. This participation has entailed the inservice training of selected engineers from foreign governments, the accommodation of visiting foreign nationals at Civil Works projects and activities, the design and procurement of dredging plant for foreign governments, and the provision of engineering information and literature relating to the development of water resources.

During the fiscal year, training in flood control, harbor development, and hydroelectric power was provided foreign nationals from the following countries:

Argentina	Egypt	Philippines
Australia	Greece	Taiwan
Brazil	Korea	Turkey
Burma	Lebanon	Vietnam

In addition, the Corps of Engineers received foreign government representatives and engineers from various free nations and afforded them the opportunity to visit the Corps Civil Works offices and projects to observe construction, organizations, and techniques. Foreign nationals from the following countries requested and received permission to visit the Civil Works activities at Corps of Engineers installations:

Australia	Germany	Mexico
Brazil	Iceland	Pakistan
Canada	India	Philippines
Chile	Iran	Portugal
China (Taiwan)	Iraq	Sweden
Egypt	Israel	Switzerland
England	Italy	Thailand
Ethiopia	Japan	Vietnam
France	Lebanon	

Upon request, engineering information pertaining to the Corps Civil Works program was furnished to foreign engineers and government representatives.

Design of a 16-inch pipeline dredge, floating and shore pipe, and attendant tug for Vietnam was completed. Construction of this equipment is essentially completed and delivery is expected to be made early in fiscal year 1962.

A transportation study and report of existing and needed facilities in Pakistan was undertaken for AID. All methods of modern transportation were considered; viz: ports, inland waterways, railways, highways, and airways. Fieldwork was completed. The recommendations of the Chief of Engineers are being prepared.

10. PUBLICATIONS OF THE CORPS OF ENGINEERS

The following publications pertaining to Civil Works activities were issued during fiscal year 1961.

A. Available at the Government Printing Office, Washington 25, D.C., at indicated price:

1. Port Series:	
No. 11—Ports of Hampton Roads, Va	$2.75
No. 24—The Port of Houston, Tex	1.50
No. 25—The Port of Corpus Christi, Tex	1.00
2. Transportation Series:	
No. 3—Transportation Lines on the Great Lakes System, 1961	.60
No. 4—Transportation Lines on the Mississippi River System and the Gulf Intracoastal Waterway, 1960	2.25
No. 5—Transportation Lines on the Atlantic, Gulf, and Pacific Coasts, 1960	3.25
3. Engineer Manuals:	
EM 1110-1-1801, Geological Investigations	.30
EM 1110-2-1902, Stability of Earth and Rockfill Dams	1.75
EM 1110-2-3001, Planning and Design of Hydroelectric Powerplant Structures	.45

B. Available at place of publication at listed price or as indicated:

1. Great Lakes Pilot, 1961. U.S. Army Engineer District, Lake Survey, Detroit 26, Mich. (including supplements)	3.50
2. Waterborne Commerce of the United States, calendar year 1960:	
Part 1.—Waterways and Harbors: Atlantic Coast. U.S. Army Engineer Division, New England, Waltham, Mass., or U.S. Army Engineer District, Lake Survey, Detroit 26, Mich	1.30
Part 2—Waterways and Harbors: Gulf Coast, Mississippi River System and Antilles. U.S. Army Engineer Division, Lower Mississippi Valley, Vicksburg, Miss., or U.S. Army Engineer District, Lake Survey, Detroit 26, Mich	1.20
Part 3—Waterways and Harbors: Great Lakes. U.S. Army Engineer District, Lake Survey, Detroit 26, Mich	.85
Part 4—Waterways and Harbors: Pacific Coast, Alaska, and Pacific Islands. U.S. Army Engineer District, San Francisco, San Francisco 19, Calif., or U.S. Army Engineer District, Lake Survey, Detroit 26, Mich	1.00
Part 5—National Summaries: U.S. Army Engineer District, Lake Survey, Detroit 26, Mich	.35
Supplement to Part 5—Domestic Inland Traffic, Areas of Origin and Destination of Principal Commodities. U.S. Army Engineer District, Lake Survey, Detroit 26, Mich	.35

Division and District addresses:

U.S. Army Engineer Division, Lower Mississippi Valley, Post Office Box 80, Vicksburg, Miss.

U.S. Army Engineer District, Memphis, Post Office Box 97, Memphis 1, Tenn.

U.S. Army Engineer District, New Orleans, Post Office Box 60267, foot of Prytania Street, New Orleans 60, La.

U.S. Army Engineer District, St. Louis, 420 Locust Street, St. Louis 2, Mo.

U.S. Army Engineer District, Vicksburg, Post Office Box 60, Vicksburg, Miss.

U.S. Army Engineer Division, Missouri River, Post Office Box 1216, Omaha, Nebr.:
- U.S. Army Engineer District, Kansas City, 911 Walnut Street, Kansas City 6, Mo.
- U.S. Army Engineer District, Omaha, 215 North 17th Street, Omaha 2, Nebr.

U.S. Army Engineer Division, New England, 424 Trapelo Road, Waltham 54, Mass.

U.S. Army Engineer Division, North Atlantic, 1216 Federal Office Building, 90 Church Street, New York 7, N.Y.:
- U.S. Army Engineer District, Baltimore, Post Office Box 1715, Baltimore 3, Md.
- U.S. Army Engineer District, New York, 111 East 16th Street, New York 3, N.Y.
- U.S. Army Engineer District, Norfolk, Post Office Box 119, Norfolk, Va.
- U.S. Army Engineer District, Philadelphia, Post Office Box 8629, Philadelphia, Pa.

U.S. Army Engineer Division, North Central, 536 South Clark Street, Chicago 5, Ill.:
- U.S. Army Engineer District, Buffalo, foot of Bridge Street, Buffalo 7, N.Y.
- U.S. Army Engineer District, Chicago, 536 South Clark Street, Chicago 5, Ill.
- U.S. Army Engineer District, Detroit, Post Office Box 1027, Detroit 31, Mich.
- U.S. Army Engineer District, Rock Island, Clock Tower Building, Rock Island, Ill.
- U.S. Army Engineer District, St. Paul, 180 East Kellog Boulevard, St. Paul 1, Minn.
- U.S. Army Engineer District, Lake Survey, 630 Federal Building, Detroit 26, Mich.

U.S. Army Engineer Division, North Pacific, 210 Custom House, Portland 9, Oreg.:
- U.S. Army Engineer District, Alaska, Post Office Box 7002, Anchorage, Alaska.
- U.S. Army Engineer District, Portland, 628 Pittock Block S.W., 10th Avenue and Washington Street, Portland 5, Oreg.
- U.S. Army Engineer District, Seattle, 1519 South Alaskan Way, Seattle 4, Wash.
- U.S. Army Engineer District, Walla Walla, Building 602, City-County Airport, Walla Walla, Wash.

U.S. Army Engineer Division, Ohio River, Post Office Box 1159, Cincinnati, Ohio:
- U.S. Army Engineer District, Huntington, Post Office Box 2127, Huntington 18, W. Va.
- U.S. Army Engineer District, Louisville, Post Office Box 59, Louisville 1, Ky.
- U.S. Army Engineer District, Nashville, Post Office Box 1070, Nashville, Tenn.
- U.S. Army Engineer District, Pittsburgh, 925 New Federal Building, Pittsburgh 19, Pa.

U.S. Army Engineer Division, Pacific Ocean, Building 96, Fort Armstrong, Honolulu 13, Hawaii:
- U.S. Army Engineer District, Honolulu, Building 96, Fort Armstrong, Honolulu 13, Hawaii.

U.S. Army Engineer Division, South Atlantic, Post Office Box 1889, Atlanta, Ga.:
- U.S. Army Engineer District, Charleston, Post Office Box 905, Charleston, S.C.
- U.S. Army Engineer District, Jacksonville, Post Office Box 4970, Jacksonville 1, Fla.
- U.S. Army Engineer District, Mobile, Post Office Box 1169, Mobile, Ala.
- U.S. Army Engineer District, Savannah, Post Office Box 889, Savannah, Ga.

U.S. Army Engineer District, Wilmington, Post Office Box 1890, Wilmington, N.C.

U.S. Army Engineer Division, South Pacific, 630 Sansome Street, Room 1216, San Francisco 11, Calif.:

U.S. Army Engineer District, Los Angeles, Post Office Box 17277, Foy Station, Los Angeles, Calif.

U.S. Army Engineer District, Sacramento, Post Office Box 1739, Sacramento, Calif.

U.S. Army Engineer District, San Francisco, 180 New Montgomery Street, San Francisco, Calif.

U.S. Army Engineer Division, Southwestern, 1114 Commerce Street, Dallas 2, Tex.:

U.S. Army Engineer District, Albuquerque, Post Office Box 1538, Albuquerque, N. Mex.

U.S. Army Engineer District, Fort Worth, Post Office Box 1600, Fort Worth, Tex.

U.S. Army Engineer District, Galveston, Post Office Box 1229, Galveston, Tex.

U.S. Army Engineer District, Little Rock, Post Office Box 867, Little Rock, Ark.

U.S. Army Engineer District, Tulsa, Post Office Box 61, Tulsa, Okla.

Chapter VII

ECONOMY MEASURES

Effective steps were taken during the year to increase efficiency and economy in the supervision and administration of the Civil Works program as well as in operational performance through improved organization and procedures, and by changes in working methods. Sound business management efforts have been intensified to provide an offsetting factor against higher price levels and increasingly complex water resource problems. Significant economies have been realized.

Organization. Significant savings of over 1,600 employees and $13 million a year has been realized by reorganizing the nationwide Corps of Engineers field organization that handles the combined military construction and Civil Works programs. This reorganization withdrew the military mission from 12 engineer districts, thus concentrating the military program in 19 districts, with a major saving in both technical and administrative personnel; 2 area offices in the New England Division were eliminated, and the Washington District was reduced in size and scope to area status. The relatively small district offices at Charleston, S.C., and Wilmington, N.C., and the Western Ocean District in New York City were reorganized so that they would receive technical and administrative support from a neighboring engineer district as a means of achieving economies in personnel and costs.

Kansas City and Omaha Districts reorganized their area and resident engineer offices and, where feasible, consolidated separate offices for military and Civil Works projects, at a saving of 134 employees and $1,132,000 a year.

Maintenance and repair activities of the St. Louis and New Orleans Districts have been reorganized at a saving of 38 employees and $251,000 a year in their shops and yards operation.

The organization and staffing of the area office at San Juan, P.R., has been realined to correspond to program reductions, saving 52 employees and $350,000 a year. The Walla Walla, Wash., District, by careful scheduling of construction operations for Ice Harbor and Lower Monumental Dams, reduced manpower requirements by establishing a single resident engineer office to supervise construction of both projects, saving 14 employees and $95,000 a year.

Floating and other plant operations. Constant review is maintained to find ways of improving the efficiency and utilization of existing plant to replace obsolete units and make increased use of available commercial facilities. In connection therewith, the following changes relating to major items of plant have been effected:

Initiated design for the conversion of hopper dredges *Comber* and *Goethals* to provide a capability for pumping direct from the hopper through a pipeline to disposal areas ashore. Upon completion, these dredges will replace the present capability of the sump rehandler *New*

Orleans and eliminate the necessity for its replacement at an estimated cost of $8 million. Operating costs will also be substantially reduced.

Initiated design of a new hopper dredge to replace the obsolete hopper dredge *Mackenzie* for operation in the coastal waters of the Gulf of Mexico.

A new towboat to replace the 33-year-old stern-wheel steamer *Mississippi* was commissioned.

Initiated the construction of a new type shallow-draft survey boat for use in shallow water of the Great Lakes. This vessel consists of a catamaran hull powered by two hydrojets.

The dipper dredge *St. Paul* and the pipeline dredge *Grafton* were disposed of by public sale.

Studies and investigations are continuing in connection with improving the design and increasing the operating efficiency of dredge pumps, pipelines, dragheads, and distribution systems, and the testing and evaluation of commercially available radio waves which will permit accurate positioning of dredges and survey boats in fog or other inclement weather.

The following are examples of outstanding management improvements related to plant operations which are presently in effect and have been evaluated and reported this fiscal year:

The shop operations in the New Orleans District had, for many years, consisted of a large-scale marine repair activity, together with maintenance of the district office reservation and land plant. Changes in construction work methods and reduction in the amount of floating plant had progressively reduced the workload of the shop forces. The work forces, which were originally organized on the basis of primary skills such as carpenter crew, sheet metal crew, refrigeration and air-conditioning crew, general labor crew and a security watch, were reorganized into three basic work groups consisting of a repair unit, a maintenance unit, and a general labor unit. This provided for a better utilization of journeymen and more flexibility within each unit, as well as within the total force. The security watch which was maintained for the floating plant fleet was abolished, and security made a part of the regular guard force. This improvement resulted in a direct monetary saving of $114,000 immediately, and the additional benefits which were realized through a smoother and a tighter-knit organization.

The hopper dredges *Comber* and *Gerig* originally had a distribution box with gates to regulate flow to the hopper bins. A bin tender was employed to manage the distribution by controlling these gates. This distribution system required constant supervision of a bin tender, and also required an excessive amount of maintenance. A single pipe system was developed which provided for a more even distribution of solids into the hoppers, which could be controlled from the drag tender's house. Trimming the ship, which was a major problem under the old system, is accomplished with this system by the drag tender regulating the discharge into the after hopper without any appreciable effect on the pump head or pumping time. It is anticipated that the elimination of the distribution box will reduce the annual maintenance by approximately $10,000, and it is estimated that there will be annual savings due to decreased pumping time of approximately $18,000.

Supply. Improvements achieved in Civil Works supply operations resulted in a saving of approximately $13 million, of which approximately $10.5 million represented the utilization of excess personal property for replacement of major items of plant and equipment, such as barges, cranes, launches, towboats, and tractors, etc. This saving was realized through the acquisition of personal property excess to Department of Defense and other Federal agencies' requirements, in lieu of by procurement from commercial sources.

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Chapter VIII

WATERBORNE COMMERCE OF THE UNITED STATES

The waterborne commerce of the United States amounted to 1,099.9 million tons and 220.3 billion ton-miles during calendar year 1960, representing gains of 4.5 percent and 12.0 percent, respectively, over the previous year. Comparable 1959 totals were 1,052.4 million tons and 196.6 billion ton-miles. The figures for 1960, both tons and ton-miles, were the second highest of record, exceeded only by the 1,131.4 million tons and 231.8 billion ton-miles in 1957.

Total domestic traffic amounted to 760.6 million tons, 4.7 percent higher than the 726.7 million tons in 1959. Great Lakes domestic traffic showed the greatest improvement with an increase of 23.9 million tons to 155.1 million tons for the year. Internal traffic rose 3.1 percent to a record total of 291.1 million tons, and a new high of 209.2 million tons was reported for the coastwise trade, 3.7 million tons greater than 1959. Local and intraport traffic, with a combined total of 104.2 million tons, was 2.6 million tons lower than the previous year.

The foreign traffic total of 339.3 million tons represented a gain of 13.6 million tons over the 1959 total of 325.7 million tons. Exports at 128.0 million tons were 14.1 percent higher than last year, while imports fell from 213.5 million tons to 211.3 million tons, the first decrease for this category since 1942. Direct traffic to oversea ports from U.S. Great Lakes ports by way of the St. Lawrence Seaway increased from 3.9 million tons in 1959 to 4.9 million tons in 1960; exports gained 40.5 percent and imports declined 19.0 percent.

The advance in ton-miles of freight carried on the U.S. waterways was led by the Great Lakes System which increased from 79.9 billion ton-miles to 99.5 billion ton-miles. The Mississippi River System with 69.3 billion ton-miles was 3.5 billion ton-miles higher than last year, while the other waterways were fractionally higher with 51.3 billion ton-miles for the year.

Tabulations showing total freight handled at ports and carried on the waterways improved by the Corps of Engineers under congressional authorization are presented in appendix B. Detailed data on the commodities handled and the vessel trips at individual ports and waterways are contained in the publications listed in paragraph B2, section 10, of chapter VI.

TOTAL WATERBORNE COMMERCE OF THE UNITED STATES
1951-1960

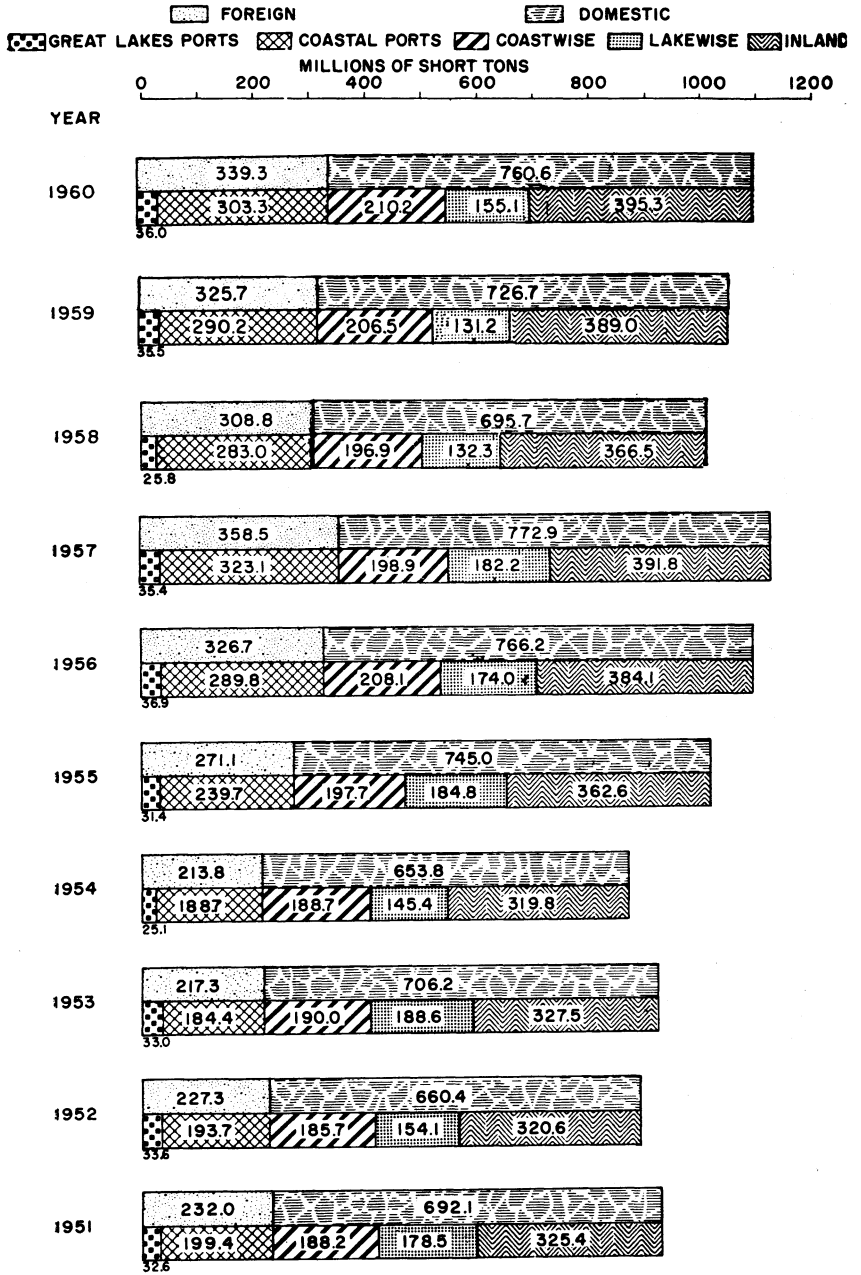

CHART VI

TON-MILES OF FREIGHT CARRIED ON THE WATERWAYS OF THE UNITED STATES, 1951-1960

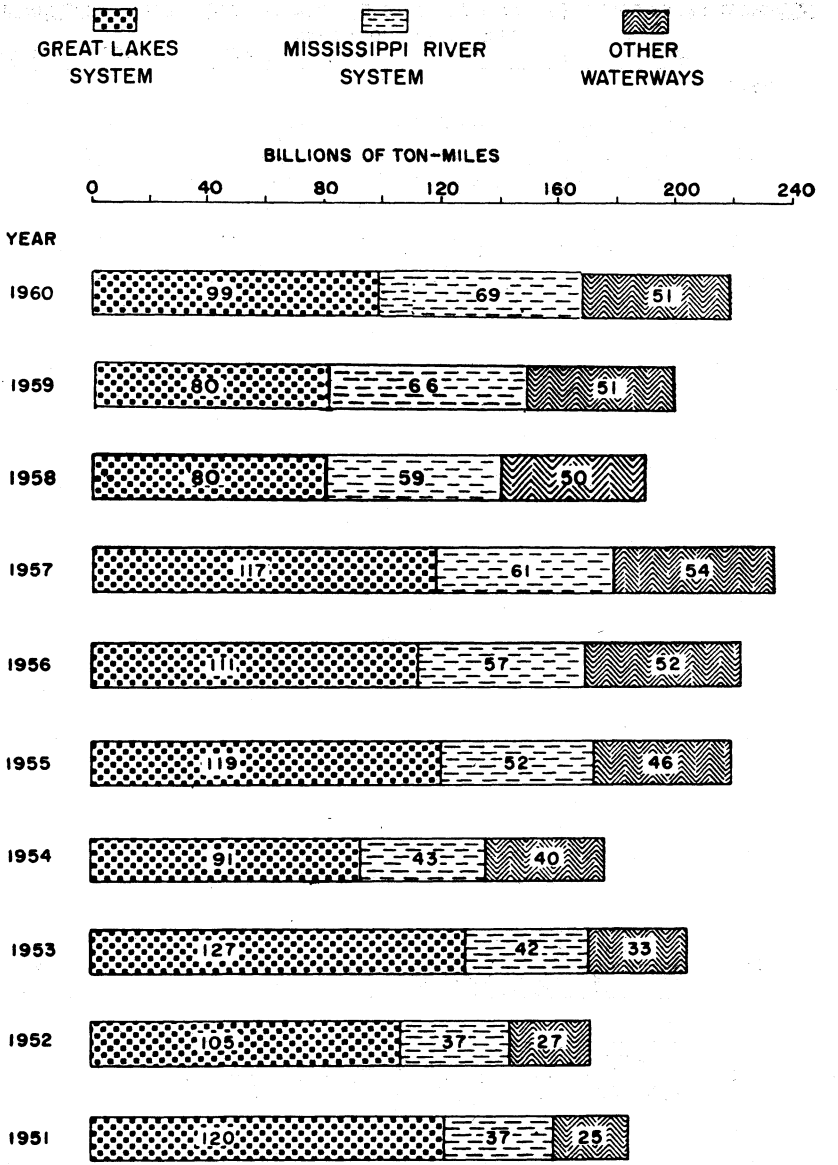

CHART VII

APPENDIX A

GENERAL

Table A–1. Status of the Active Civil Works Program, as of June 30, 1961

Status	Number of project authorizations and/or projects	Millions of dollars		
		Estimated Federal cost	Appropriations through fiscal year 1961	Required to complete after fiscal year 1961
	Summary			
A. Completed or substantially completed	2,667	$3,840	$3,801	$39
B. Underway	439	10,913	6,231	4,682
C. Authorized, not started	279	3,941	29	3,912
Total	3,385	18,694	10,061	8,633
	A. Completed or substantially completed			
1. Navigation	2,191	1,577	1,542	35
2. Flood control:				
a. General	417	1,131	1,129	2
b. Mississippi River and tributaries (see B. Underway)				
3. Multiple purpose, including power	21	1,119	1,117	2
4. Beach erosion control	28	4	4	0
5. Alteration of bridges	10	9	9	0
Total	2,667	3,840	3,801	39
	B. Underway			
1. Navigation	192	$2,398	$1,242	$1,156
2. Flood control:				
a. General	195	3,097	1,497	1,600
b. Mississippi River and tributaries	1	1,768	1,163	605
3. Multiple-purpose, including power	30	3,617	2,303	1,314
4. Beach erosion control	14	9	3	6
5. Alteration of bridges	7	24	23	1
Total	430	10,913	6,231	4,682
	C. Authorized, not started			
1. Navigation	67	1,502	9	1,493
2. Flood control:				
a. General	160	1,405	13	1,392
b. Mississippi River and tributaries (see B. Underway				
3. Multiple-purpose, including power	11	993	7	986
4. Beach erosion control	39	25		25
5. Alteration of bridges	2	16		16
Total	279	3,941	29	3,912

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Table A–2. Functional Allocation[1] of Appropriations

(In millions of dollars) (By fiscal years)

Function	Cumulative through 1961	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	Cumulative through 1949
New Work[2] (subtotal)	(10,585)	(756)	(712)	(659)	(493)	(504)	(455)	(338)	(314)	(452)	(476)	(517)	(531)	(4,388)
Navigation	3,921	259	250	228	168	167	125	77	61	78	95	99	105	2,209
Flood control	4,207	313	308	295	235	225	167	115	105	180	183	208	256	1,617
Power	2,275	170	142	125	83	103	139	135	137	180	183	195	158	525
Beach erosion control	8	1	1	1		1	3				1			
Other[3]	174	13	11	10	7	8	11	11	11	14	14	15	12	37
Operation and maintenance (subtotal)	(2,990)	(151)	(136)	(133)	(121)	(113)	(147)	(90)	(96)	(99)	(135)	(88)	(98)	(1,583)
Navigation	2,349	106	94	90	87	87	76	70	74	76	68	69	82	1,370
Flood control	524	28	26	29	21	15	61	13	15	20	64	16	13	203
Power	111	16	15	13	12	10	9	7	7	3	3	3	3	10
Other[3]	6	1	1	1	1	1	1							
Surveys, administration, and miscellaneous (subtotal)	(375)	(29)	(25)	(24)	(25)	(22)	(20)	(16)	(16)	(11)	(6)	(14)	(12)	(155)
Navigation	166	12	10	10	11	9	7	6	5	3	2	4	4	83
Flood control	138	11	10	10	10	9	8	5	5	4	2	5	5	54
Power	66	6	5	4	4	4	5	5	6	4	2	5	3	13
Beach erosion control														
Other[3]	5													5
Total	13,950	936	873	816	639	639	612	444	426	562	617	619	641	6,126

[1] Appropriations for "Multiple-Purpose Projects Including Power" are distributed to "Power, Flood Control, Navigation, and Other," as applicable. Appropriations for "Flood Control, Mississippi River and Tributaries," are distributed as follows:

	New work *Percent*	Operation and Maintenance *Percent*
Flood control	75	55
Navigation	25	45

[2] Advance Engineering and Design, and Construction.

[3] Recreation, Water Supply, Fish and Wildlife, Pollution Abatement, etc.

Table A–3. Functional Allocation of Civil Works Appropriations Cumulative Total Through Fiscal Year 1961
(In millions of dollars)

	New work	Maintenance	Surveys, administration, and miscellaneous	Total
Navigation	3,921	2,349	166	6,436
Flood control	4,207	524	138	4,869
Hydroelectric power	2,275	111	66	2,452
Beach erosion control	8			8
Other	174	6	5	185
Total	10,585	2,990	375	13,950

Table A–4. Reservoir Data as of June 30, 1961
Storage in millions of acre-feet
Locks and dams (navigation pools) having hydropower features are included

	Region	Completed or in partial operation		Under construction, not operable		Authorized, not started		Total active		Deferred inactive		Total of active deferred inactive
		Number	Storage	Number	Storage	Number	Storage	Number	Storage	Number	Number	Number
1	Alaska											
2	Arkansas-Red-White	28	30.536	11	15.452	16	5.351	55	51.339	5	3	63
3	Central Valley	14	3.096	3	.635	7	1.935	24	5.666		1	25
4	Colorado	5	2.561			2	1.078	7	3.639			7
5	Columbia	16	6.114	5	3.536	8	7.221	29	16.871			29
6	Great Basin					3	.050	3	.050	3		6
7	Great Lakes and St. Lawrence	6	.452					6	.452		1	7
8	Hawaii											
9	Lower Mississippi	5	4.717					5	4.717			5
10	Missouri	13	78.550	4	3.625	22	6.820	39	88.995	3	3	45
11	New England	20	.820	4	.185	13	.413	37	1.418	1	10	48
12	North Atlantic	13	3.521			9	.595	22	4.116	3		25
13	North Pacific	1	.106	1	.106			2	.212			2
14	Ohio	44	15.854	11	6.497	12	2.657	67	25.008	23	6	96
15	Souris and Red	5	1.269					5	1.269		2	7
16	South Atlantic and East Gulf	*4	*6.492	3	3.936	3	.620	10	11.048	16		26
17	South Pacific	11	.489			1	.085	12	.574		4	16
18	Upper Mississippi	11	2.827	4	2.900	3	1.325	18	7.052	5	2	25
19	West Gulf	12	6.293	7	6.777	9	3.164	28	16.234		5	33
	Total (rounded)	208	164	53	44	108	31	369	239	59	37	465

*The Central and Southern Florida project, consisting of some 21 lakes and conservation impoundments with 10,687,000 acre-feet of storage, is not included.

Table A–5. Reservoirs

Change of status during fiscal year 1961

To "Completed or Operable" from "Under Construction"

(Storage in thousands of acre-feet)

Region	*Reservoir*	*Storage*
Colorado	Whitlow Ranch, Ariz	36
Columbia	Hills Creek, Oreg	356
Do	Ice Harbor, Wash	417
Missouri	Pomme de Terre, Mo	650
New England	Ball Mountain, Vt	55
Do	North Hartland, Vt	71
Do	North Springfield, Vt	51
Do	Thomaston, Conn	42
Do	Townshend, Vt	34
Do	West Hill, Mass	12
North Atlantic	Bear Creek, Pa	110
Do	Kettle Creek, Pa	75
Do	Prompton, Pa	51
Do	Stillwater, Pa	12
Ohio	Dillon, Ohio	274
South Pacific	Carbon Canyon, Calif	7
Upper Mississippi	Pigeon Creek, Ill	7
	Total—17 reservoirs	2,260

To "Under Construction" from "Authorized, not Started"

(Storage in thousands of acre-feet)

Arkansas-Red-White	Broken Bow, Okla	534
Do	Millwood, Ark	1,868
Columbia	Green Peter, Oreg	430
Do	Lower Monumental, Wash	247
Missouri	Milford, Kans	740
Ohio	Fishtrap, Ky	168
Do	Monroe, Ind	446
Do	Salamonie, Ind	239
	Total—8 reservoirs	4,672

To "Deferred" from "Active"

Region	*Reservoir*
Ohio	Celina, Ky.

To "Deferred" from "Inactive"

None

To "Inactive" from "Deferred"

Ohio	Haysi, Va.
Do	J. Percy Priest (Stewarts Ferry), Tenn.
Do	Mining City, Ky.

To "Inactive" from "Authorized"

Upper Mississippi	Joanna, Mo.
West Gulf	Alamogordo, N. Mex.
Do	Los Esteros, N. Mex.

Table A–5. Reservoirs—Continued

To "Deauthorized" from "Inactive"

New England—West Brookfield, Mass.*

To "Deauthorized" from "Active"

Columbia—White Bridge, Oreg. (reregulating dam; replaced by Foster).

*Deauthorized by sec. 203, F.C. Act July 14, 1960, Public Law 86–645.

To "Authorized Active" from "Deferred"

South Atlantic and East Gulf—Carters, Ga.
Replaces:
Do—Lower Coosawattee, Ga.
Do—Upper Coosawattee, Ga.

To "Authorized Active" from "Inactive"

None

Table A–6. Reservoirs

Authorized by 1960 Act

(Public Law 86–645, July 14, 1960)

(Storage in thousands of acre-feet)

Region	*Reservoir*	*Storage*
Colorado	Tahchevah Creek, Calif	1
Columbia	Foster, Oreg.*	61
Great Basin	Keystone, Nev. (and Gleason Cr. L.P.)	2
Do	Little Dell, Utah	8
Do	West Fork, Calif	40
New England	Black Rock, Conn	9
Do	Colebrook, Conn	82
Do	Conant Brook, Mass	4
Do	Hancock Brook, Conn	4
Do	Hop Brook, Conn	7
Do	Northfield Brook, Conn	2
Do	Sucker Brook, Conn	1
Do	West Thompson, Conn	26
Ohio	Grayson, Ky	144
Do	Laurel River, Ky	444
Do	North Fork, Va	11
West Gulf	Blieders Creek, Tex	8
Do	Cochiti, N. Mex	597
Do	Galisteo, N. Mex	130
Do	Bardwell, Tex	118

*Reregulating dam; replaces White Bridge.

Appendix B

NAVIGATION

Table B–1. Total Waterborne Commerce of the United States, Calendar Years 1950–60

(In millions of tons of 2,000 pounds)

Year	Total	Foreign						Domestic						
		Imports			Exports			Total	Coastwise	Lakewise	Internal	Intraport	Local	Intraterritory
		Total	Coastal ports	Great Lakes ports	Total	Coastal ports	Great Lakes ports							
1950	820.6	102.0	96.3	5.7	67.2	43.6	23.6	651.4	182.5	169.9	190.8	51.7	55.2	1.2
1951	924.1	108.7	101.8	6.9	123.3	97.6	25.7	692.1	186.8	178.5	213.4	51.0	61.1	1.4
1952	887.7	116.0	108.7	7.3	111.4	85.1	26.3	660.4	184.2	154.1	216.6	49.2	54.8	1.5
1953	923.5	128.0	120.6	7.4	89.4	63.8	25.6	706.2	188.8	188.6	225.0	47.9	54.7	1.3
1954	867.6	129.4	123.5	5.9	84.4	65.2	19.2	653.8	187.2	145.4	217.1	48.0	54.7	1.4
1955	1,016.1	153.0	144.3	8.7	118.1	95.4	22.7	745.0	195.7	184.8	249.7	52.9	60.0	2.0
1956	1,092.9	174.2	163.3	10.9	152.5	126.5	26.0	766.2	205.9	174.0	269.7	53.1	61.3	2.2
1957	1,131.4	186.4	176.2	10.1	172.2	146.9	25.3	772.9	196.4	182.2	281.1	50.2	60.6	2.4
1958	1,004.5	189.5	181.5	8.0	119.4	101.6	17.8	695.7	194.1	132.3	261.1	48.9	56.5	2.8
1959	1,052.4	213.5	198.6	14.9	112.2	91.6	20.6	726.7	205.5	131.2	282.3	49.7	57.1	[1] 1.0
1960	1,099.9	211.3	198.5	12.9	128.0	104.8	23.2	760.6	209.2	155.1	291.1	49.5	54.7	1.0

[1] Traffic within the States of Alaska and Hawaii transferred to other domestic traffic categories.

NOTE.—Totals represent the sums of unrounded figures, hence they may vary slightly from the sums of the rounded amounts.

Table B–2. Commerce at Project Harbors, Calendar Year 1960

(In tons of 2,000 pounds)

Harbor	Tons
ALABAMA	
Chickasaw Creek	877,310
Fly Creek (Fairhope)	893
Dauphin Island Bay	1,572
Guntersville	1,396,535
Mobile Harbor	17,718,817
Three Mile Creek	4,298,454
ALASKA	
Anchorage Harbor	246,758
Cordova Harbor	34,885
Craig Harbor	1,487
Dillingham Harbor	8,261
Elfin Cove	106
Homer Harbor	11,780
Iliuliuk Harbor (Dutch Harbor)	170,990
Juneau Harbor	133,786
Ketchikan Harbor	1,016,383
Kodiak Harbor	38,289
Metlakatla Harbor	5,997
Nome Harbor	37,478
Pelican Harbor	6,638
Petersburg Harbor	42,794
Port Alexander *	----------
Seldovia Harbor	11,037
Seward Harbor	628,422
Sitka Harbor	605,280
Skagway Harbor	61,000
Valdez Harbor	72,746
Whittier Harbor	115,420
Wrangell Harbor	243,614
ARKANSAS	
Helena	1,769,498
CALIFORNIA	
Crescent City Harbor	342,801
Humboldt Harbor and Bay	788,863
Long Beach Harbor	9,397,856
Los Angeles Harbor	22,494,622
Monterey Harbor	139,618
Morro Bay Harbor	5,199
Moss Landing Harbor	226,222
Newport Bay Harbor	3,204
Oakland Harbor	4,245,444
Redondo Beach (King Harbor)	82
Redwood City Harbor	3,240,811
Richmond Harbor	17,263,796
San Diego Harbor	2,135,798
San Francisco Harbor	4,366,345
Santa Barbara Harbor	2,254
Stockton	3,311,395
CONNECTICUT	
Branford Harbor*	----------
Bridgeport Harbor	2,090,396
Clinton Harbor*	----------
Duck Island Harbor*	----------
Fivemile River Harbor	1,298
Greenwich Harbor	78,151
Milford Harbor	3,844
New Haven Harbor	7,932,905
New London Harbor	1,114,018
Norwalk Harbor	592,765
Southport Harbor*	----------
Stamford Harbor	793,100
Stonington Harbor	1,425
Westport Harbor and Saugatuck River	9,581
DELAWARE	
Wilmington Harbor	2,230,755
DISTRICT OF COLUMBIA	
Washington Harbor	2,686,295
FLORIDA	
Apalachicola Bay	18,277
Bayou Chico	127,633
Canaveral Harbor	301,321
Carrabelle Harbor	9,515
Cedar Keys Harbor	1,390
Charlotte Harbor	1,349,182
Eau Gallie Harbor	250
Fernandina Harbor	148,625
Fort Pierce Harbor	136,831
Jacksonville Harbor	7,450,977
Key West Harbor	200,167
Melbourne Harbor	73
Miami Harbor	1,611,638
Palm Beach Harbor	731,712
Panama City Harbor	1,069,200
Pensacola Harbor	792,443
Port Everglades Harbor	4,693,240
Port St. Joe Harbor	1,620,083
St. Augustine Harbor	3,599
St. Petersburg Harbor	577,631
Tampa Harbor	14,786,470
GEORGIA	
Brunswick Harbor	787,312
Darien Harbor	1,704
Savannah Harbor	4,325,230
HAWAII	
Hilo Harbor, Hawaii	807,780
Honolulu Harbor, Oahu	5,041,339
Kahului Harbor, Maui	638,032
Kaunakakai Harbor, Molokai	225,230
Kawaihae Harbor, Hawaii	95,037
Nawiliwili Harbor, Kauai	376,457
Port Allen Harbor, Kauai	130,026
ILLINOIS	
Calumet Harbor and River	21,134,496
Chicago Harbor	588,630
Port of Chicago	38,814,182
Waukegan Harbor	240,487
INDIANA	
Calumet Harbor and River	21,134,496
Indiana Harbor	19,761,202
Michigan City Harbor	175,973
Mount Vernon	3,504,700
Port of Chicago	38,814,182
KENTUCKY	
Louisville	5,816,999
LOUISIANA	
Baton Rouge	26,585,815
Lake Charles (Calcasieu River and Pass)	17,433,441
New Orleans	56,671,652
Terrebonne Bay, La.*	----------

See footnote at end of table.

Table B–2. Commerce at Project Harbors, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Harbor	Tons
MAINE	
Bar Harbor	259
Belfast Harbor	2,219
Boothbay Harbor	628
Camden Harbor	190
Cape Porpoise Harbor	15,701
Corea Harbor	332
Hendricks Harbor	149
Isle au Haut Thoroughfare	1,343
New Harbor	132
Northeast Harbor*	----------
Portland Harbor	16,167,661
Rockland Harbor	73,944
Rockport Harbor	15
Stonington Harbor	13,951
Thomaston Harbor*	----------
Wood Island Harbor and the Pool at Biddeford	100
York Harbor	440
MARYLAND	
Annapolis Harbor	20,539
Baltimore Harbor and Channels	43,419,627
Black Walnut Harbor	405
Breton Bay	3,513
Cambridge Harbor	98,749
Claiborne Harbor	238
Crisfield Harbor	52,678
Lowes Wharf, Talbot County	1,676
Nanticoke River at Bivalve	1,927
Nanticoke River at Nanticoke	7,188
Ocean City Harbor and Inlet and Sinepuxent Bay	7,489
Queenstown Harbor	92
Rock Hall Harbor	8,399
Tilghman Island Harbor	5,258
MASSACHUSETTS	
Beverly Harbor	144,963
Boston, main waterfront	5,813,690
Cohasset Harbor	247
Cuttyhunk Harbor	606
Duxbury Harbor	136
Edgartown Harbor	4,000
Fall River Harbor	2,942,912
Gloucester Harbor	171,536
Harbor of Refuge, Nantucket	26,717
Hingham Harbor*	----------
Lynn Harbor	3,623
Manchester Harbor	181
Marblehead Harbor	525
New Bedford and Fairhaven Harbor	224,263
Newburyport Harbor	12
Plymouth Harbor	6,879
Pollock Rip Shoals, Nantucket Sound*	----------
Port of Boston	19,019,567
Provincetown Harbor	13,522
Rockport Harbor	252
Salem Harbor	1,382,796
Scituate Harbor	380
Vineyard Haven Harbor	50,375
Wellfleet Harbor*	----------
MICHIGAN	
Algonac	15,449
Alpena Harbor	2,434,821
Au Sable Harbor and River (Oscoda)	538
Big Bay Harbor	666
Black River Harbor	32
Cedar River Harbor	859
Charlevoix Harbor	82,842
Cheboygan Harbor	105,006
Detour	363,746
Drummond Island	2,043,484
Frankfort Harbor	1,415,652
Gladstone Harbor	246,125
Grand Haven Harbor and Grand River	3,165,582
Grand Marais Harbor (Harbor of Refuge)	77
Grand Traverse Bay Harbor	935
Harbor Beach, Harbor of Refuge	51,582
Harrisville Harbor	64
Holland Harbor	260,933
Isle Royale*	----------
Lac La Belle Harbor	83
Leland Harbor	421
Lime Island	170,235
Ludington Harbor	3,892,308
Mackinac Harbor	18,827
Manistee Harbor	590,522
Manistique Harbor	215,845
Marine City	119,667
Marquette Harbor	925,095
Marysville	218,940
Menominee Harbor	746,268
Monroe Harbor	33,211
Muskegon Harbor	3,572,698
Ontonogan Harbor	11,092
Pentwater Harbor	49
Pine River	173
Port Huron	571,063
Port of Detroit	27,478,201
Port Sanilac Harbor	103
Presque Isle Harbor	4,340,418
Rogers City Harbor	82
St. Clair	2,091,439
St. James Harbor (Beaver Island)	3,594
St. Joseph Harbor	493,637
Saugatuck Harbor and Kalamazoo River	438
Sault Ste. Marie	340,590
Sebewaing	62
South Haven Harbor	74,174
Traverse City Harbor	175,423
Whitefish Point Harbor	182
White Lake Harbor	10,060
MINNESOTA	
Baudette Harbor*	----------
Beaver Bay Harbor	45
Duluth-Superior Harbor	42,677,800
Grand Marais Harbor	47,649
Knife River Harbor	93
Lutsen Harbor	24
Minneapolis	606,073
St. Paul	3,991,232
Two Harbors (Agate Bay)	15,266,451
Warroad Harbor	1,520
Zippel Bay*	----------
MISSISSIPPI	
Biloxi Harbor	156,346
Greenville	1,079,884
Gulfport Harbor	466,910
Natchez	615,230
Pascagoula Harbor	566,200
Pass Christian Harbor	635
Vicksburg	925,640
MISSOURI	
Kansas City	1,373,794
St. Louis	9,091,940
NEW HAMPSHIRE	
Portsmouth Harbor	1,397,389

See footnote at end of table.

Table B–2. Commerce at Project Harbors, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Harbor	Tons
NEW JERSEY	
Keyport Harbor*	----------
NEW YORK	
Barcelona	34
Cape Vincent Harbor*	----------
Dunkirk Harbor	11,930
Echo Bay Harbor	131,223
Great Kills Harbor, Staten Island	1,155
Great Sodus Bay Harbor	1,217,993
Greenport Harbor	23,125
Hay (West) Harbor	2,329
Hempstead Harbor	5,912,339
Huntington Harbor	496,656
Lake Montauk Harbor	1,655
Mamaroneck Harbor	88,657
Mattituck Harbor	72,326
New Rochelle Harbor	550
Niagara Falls	28,278
Northport Harbor	17,414
Ogdensburg Harbor	394,309
Oswego Harbor	984,637
Peekskill Harbor	207,028
Plattsburg Harbor*	----------
Port Chester Harbor	608,863
Port Henry Harbor	8,827
Port Jefferson Harbor	1,285,435
Port of Buffalo	17,703,834
Port of New York	153,198,620
Rochester (Charlotte) Harbor	388,727
Rondout Harbor	580,126
Sackets Harbor	77,263
Sag Harbor	23,587
Saugerties Harbor*	----------
Tarrytown Harbor	653,776
Tonawanda Harbor	654,358
Waddington Harbor	88,320
Wilson Harbor	1
NORTH CAROLINA	
Beaufort Harbor	85,280
Belhaven Harbor	25,270
Edenton Harbor	49,724
Manteo (Shallowbag) Bay	20,824
Morehead City Harbor	678,986
Port of Wilmington (see also Wilmington Harbor, N.C., for waterway data)	4,179,751
Silver Lake Harbor	2,516
OHIO	
Ashtabula Harbor	10,240,265
Cincinnati	7,430,239
Cleveland Harbor	17,801,218
Conneaut Harbor	7,158,144
Fairport Harbor	2,808,380
Huron Harbor	2,206,508
Lorain Harbor	7,009,155
Port Clinton Harbor	18,877
Put In Bay	5,502
Sandusky Harbor	5,687,575
Toledo Harbor	34,040,035
Vermilion Harbor	521
OREGON	
Astoria	353,973
Coos Bay	3,225,406
Depoe Bay	92
Oregon Slough (North Portland Harbor)	380,984
Port Orford	452
Portland	13,549,332
St. Helens	243,202
Tillamook Bay and Bar	38,926
Yaquina Bay and Harbor	514,952
PENNSYLVANIA	
Aliquippa-Rochester	7,217,219
Clairton-Elizabeth	9,029,228
Erie Harbor	2,578,399
Philadelphia Harbor	44,475,458
Pittsburgh	6,581,274
RHODE ISLAND	
Great Salt Pond, Block Island	1,168
Harbor of Refuge, Block Island	2,471
Harbor of Refuge, Point Judith and Point Judith Pond	27,051
Newport Harbor	917,162
Providence River and Harbor	7,949,820
Wickford Harbor	1,101
SOUTH CAROLINA	
Charleston Harbor	4,974,962
Georgetown Harbor (Winyah Bay)	869,772
Port Royal Harbor	9,495
TENNESSEE	
Chattanooga	1,600,020
Knoxville	745,430
Memphis	6,336,252
Nashville	2,477,900
TEXAS	
Aransas Pass	97,001
Beaumont	27,113,480
Brazos Island Harbor	1,414,988
Corpus Christi	19,202,425
Freeport Harbor	3,648,739
Galveston (Galveston Channel)	6,072,922
Harbor Island	5,657,189
Houston (Houston Ship Channel)	57,132,659
Orange	1,022,784
Palacios	140,844
Port Arthur	28,207,396
Port Bolivar	2,031
Port Lavaca	2,037,369
Rockport	5,701
Sabine Pass Harbor	365,282
Texas City (Texas City Channel)	15,401,847
Victoria	252,504
VERMONT	
Burlington Harbor	422,215
VIRGINIA	
Cape Charles City Harbor	3,869
Horn Harbor	3,587
Monroe Bay and Creek	2,970
Norfolk Harbor	36,860,320
Port of Newport News	12,678,372
Port of Richmond	2,917,487
Portsmouth Harbor, Channel to Nansemond Ordnance Depot*	----------
Potomac River at Alexandria	417,374
Winter Harbor	1,533
WASHINGTON	
Anacortes Harbor	7,710,329
Bellingham Bay and Harbor	1,708,876
Blaine Harbor	23,602
Everett Harbor	3,222,402
Grays Harbor and Chehalis River	1,770,061
Hammersley Inlet (Shelton Harbor)	910,108
Longview	2,947,859
Neah Bay	245,619

See footnote at end of table.

Table B–2. Commerce at Project Harbors, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Harbor	Tons	Harbor	Tons
WASHINGTON—Continued		WISCONSIN—Continued	
Olympia Harbor	1,058,462	Manitowoc Harbor	2,162,974
Port Angeles Harbor	1,984,594	Milwaukee Harbor	8,519,044
Port Gamble Harbor	293,327	Oconto Harbor	55
Port Townsend Harbor	771,342	Pensaukee Harbor	110
Seattle Harbor	13,391,467	Port Washington Harbor	630,227
Tacoma Harbor	5,324,244	Port Wing Harbor	278
Vancouver	2,500,149	Racine Harbor	134,239
Willapa River and Harbor, and Naselle River	450,060	Saxon Harbor	4
		Sheboygan Harbor	456,400
		Two Rivers Harbor	185,947
WEST VIRGINIA		PUERTO RICO	
Huntington	13,740,840	Arecibo Harbor*	
WISCONSIN		Fajardo Harbor	64,108
		Guayanes Harbor	9,773
Algoma Harbor	348	Mayaguez Harbor	248,615
Ashland Harbor	1,573,845	Ponce Harbor	731,565
Bayfield Harbor	2,108	San Juan Harbor	4,675,971
Cornucopia Harbor	429		
Detroit Harbor	7,045	VIRGIN ISLANDS	
Duluth-Superior	42,677,800		
Green Bay Harbor	3,401,007	Christiansted Harbor, St. Croix	20,662
Jackson Harbor	177	St. Thomas Harbor	703,996
Kenosha Harbor	39,326	Wake Island Harbor	146,503
Kewaunee Harbor	1,045,576		

*No commerce reported.

Table B–3. Commerce at Selected Areas, Calendar Year 1960

(In tons of 2,000 pounds)

Area	*Tons*
Delaware River and tributaries, Trenton, N.J., to the sea:	
Burlington-Florence-Roebling, N.J	1,367,466
Camden-Gloucester, N.J	4,310,070
Chester, Pa	848,561
Marcus Hook, Pa., and vicinity	18,061,977
New Castle, Del., and vicinity	11,556,296
Paulsboro, N.J., and vicinity	15,142,809
Penn Manor, Pa., and vicinity	7,862,992
Philadelphia Harbor, Pa	44,475,458
Riverton-Delanco-Beverly, N.J	1,021,782
Trenton Harbor, N.J	376,727
Wilmington Harbor, Del	2,230,755
Other	1,474,722
Gross total	108,729,615
Net total	98,229,372
Hampton Roads, Va.:	
Channel from Phoebus, Va., to deepwater in Hampton Roads	2,948
Hampton Creek, Va	354,460
Norfolk Harbor, Va	36,860,320
Port of Newport News, Va	12,678,372
Other	77,280
Gross total	49,973,380
Net total	49,955,853
Corpus Christi Bay, Tex.:	
Corpus Christi, Tex	19,202,425
Harbor Island, Tex	5,657,189
Gross total	24,859,614
Net total	24,840,443

Table B–3. Commerce at Selected Areas, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Area	Tons
San Francisco Bay, Calif.:	
Carquinez Strait, Calif.	8,392,399
Oakland Harbor, Calif.	4,245,444
Redwood City Harbor, Calif.	3,240,811
Richmond Harbor, Calif.	17,263,796
Sacramento River, Calif.	2,120,899
San Francisco Harbor, Calif.	4,366,345
San Joaquin River and tributaries, Calif.	4,313,471
San Pablo Bay and Mare Island Strait, Calif.	2,622,693
Suisun Bay Channel, Calif.	4,784,623
Other	3,189,315
Gross total	54,539,796
Net total	44,532,788
Chicago, Ill., and Ind.:	
Buffington Harbor, Ind.	1,544,377
Calumet Harbor and River, Ill., and Ind.	21,134,496
Chicago Harbor, Ill.	588,630
Gary Harbor, Ind.	11,676,773
Indiana Harbor, Ind.	19,761,202
Lake Calumet, Ill.	1,167,021
Other	17,943,247
Gross total	73,815,746
Net total	70,437,871

Table B–4. Ton-Mileage of Freight Carried on the Inland Waterways of the United States, by System, Calendar Year 1960

System	Ton-miles
Atlantic coast waterways	28,582,791,000
Gulf coast waterways	16,931,669,000
Pacific coast waterways	6,000,818,000
Mississippi River System, including Ohio River and tributaries	69,256,561,000
Other waterways [1]	12,498,000
Great Lakes system [2]	99,468,198,000
Total	220,252,535,000

[1] Includes Alaskan waterways.
[2] Does not include traffic between foreign ports.

Table B–5. Commerce on Project Waterways, Calendar Year 1960

(In tons of 2,000 pounds)

Waterway	Tons	Total ton-miles (000 omitted)
ATLANTIC COAST		
Abbapoola Creek, S.C.[2]		
Absecon Creek, N.J.	12	(1)
Absecon Inlet, N.J.	101,247	202
Alloway Creek, N.J.[2]		
Altamaha River, Ga.	26,822	161
Anacostia River, D.C.	1,662,778	3,326
Annisquam River, Mass.[2]		
Appomattox River, Va.[2]		
Appoquinimink River, Del.[2]		
Aquia Creek, Va.[2]		
Ashley River, S.C.	14,049	84
Atlantic Intracoastal Waterway between Norfolk, Va., and the St. Johns River, Fla. (net)	2,829,292	677,434
U.S. Army Engineer District, Norfolk:		
Via Dismal Swamp Canal Route	78,144	2,042
Via Great Bridge Lock Route	1,087,234	36,685
U.S. Army Engineer District, Wilmington	1,890,658	343,117
U.S. Army Engineer District, Charleston	1,480,843	192,510
U.S. Army Engineer District, Savannah	973,748	92,594
U.S. Army Engineer District, Jacksonville	769,221	13,496

See footnotes at end of table.

Table B–5. Commerce on Project Waterways, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton-miles (000 omitted)
ATLANTIC COAST—Continued		
Back Creek (Anne Arundel County), Md	666	(1)
Barnegat Inlet, N.J	1,043	1
Bay Ridge and Red Hook Channels, N.Y	11,625,877	46,504
Bay River, N.C	772	9
Beresford Creek, S.C.[2]		
Big Timber Creek, N.J	150,776	45
Black River, N.C.[2]		
Blackwater River, Va	75,448	1,019
Bransons Cove, Va	4,075	(1)
Broad Creek, Va	2,226	1
Broad Creek River, Del	7,183	72
Broad Creek, Somerset County, Md	6,821	22
Broadkill River, Del.[2]		
Broadwater Creek, Md.[2]		
Bronx River, N.Y	563,052	845
Browns Creek, N.Y	4,000	5
Buttermilk Channel, N.Y	4,068,680	9,358
Cadle Creek, Md.[2]		
Cape Cod Canal, Mass	12,135,469	212,371
Cape Fear River, N.C., above Wilmington	363,019	27,335
Cape May Canal, N.J	700	3
Carter Creek, Va	53,060	64
Cashie River, N.C	12,650	259
Channel between Staten Island and Hoffman and Swinburne Islands, N.Y.[2]		
Channel connecting Thoroughfare Bay with Cedar Bay, N.C	100	(1)
Channel connecting York River, Va., with Back Creek to Slaight's Wharf	3,620	4
Channel from Back Sound to Lookout Bight, N.C	602	2
Channel from Pamlico Sound to Avon, N.C	66,578	67
Channel from Pamlico Sound to Rodanthe, N.C	75	(1)
Channel from Phoebus, Va., to deep water in Hampton Roads	2,948	2
Channel to Island Creek, St. George Island, Md	38	(1)
Channel to Newport News, Va	16,215,424	52,700
Cheesequake Creek, N.J.[2]		
Chelsea River, Mass	5,617,997	8,427
Chester River, Md	69,547	1,716
Chester River, Pa.[2]		
Chincoteague Bay, Md. and Va	26,096	78
Choptank River, Md	132,085	1,909
Chowan River, N.C	116,501	4,389
Coan River, Va	8,459	17
Cockrell Creek, Va	123,950	186
Cohansey River, N.J	121,695	2,312
Cold Spring Inlet, N.J	89,430	89
Coney Island Channel, N.Y	5,339,732	6,942
Coney Island Creek, N.Y	252,154	252
Congaree River, S.C.[2]		
Connecticut River above Hartford, Conn.[2]		
Connecticut River below Hartford, Conn	2,556,308	117,590
Contentnea Creek, N.C.[2]		
Cooper River, N.J	92,845	93
Corsica River, Md	10,000	50
Courtenay Channel, Fla.[2]		
Cranes Creek, Va	432	(1)
Davis Creek, Va	20,005	10
Deep Creek, Accomac County, Va	5,771	3
Deep Creek, Warwick County, Va	3,679	7
Delaware River:		
Trenton, N.J., to the sea (net)	99,844,544	8,411,248
At Camden, N.J	1,746,221	(4)
Between Philadelphia, Pa., and Trenton, N.J	14,918,744	208,862
Harbor of Refuge, Delaware Bay, Del	160,745	241
Philadelphia, Pa., to the sea	98,823,923	8,202,386
Dennis Creek, N.J.[2]		
Dorchester Bay, Mass	42,267	42
Double Creek, N.J.[2]		
Drum Inlet, N.C.[2]		
Duck Point Cove, Md	1,540	2
Dymers Creek, Va	40,854	41
East Chester Creek, N.Y	2,082,564	7,289
East River, N.Y	51,187,730	409,502
East Rockaway Inlet, N.Y	1,267,336	760
Elizabeth River, N.J.[2]		
Elk and Little Elk Rivers, Md	12	(1)
Fancy Bluff Creek, Ga.[2]		

See footnotes at end of table.

Table B–5. Commerce on Project Waterways, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton-miles (000 omitted)
ATLANTIC COAST—Continued		
Far Creek, N.C.	13,479	27
Fire Island Inlet, N.Y.	213,322	320
Fishing Bay Tributaries, Dorchester County, Md.	4,378	4
Fishing Creek, Calvert County, Md.	35	(1)
Flushing Bay, N.Y.	2,708,152	8,666
Fort Point Channel, Mass.	178,827	89
Glen Cove Creek, N.Y.	289,358	289
Goshen Creek, N.J.[2]		
Governors Run, Md.	121	(1)
Gowanus Creek Channel, N.Y.	4,569,049	3,613
Great Pee Dee River, S.C.	15,906	159
Great South Bay, N.Y.	229,451	4,175
Hackensack River, N.J.	4,011,469	36,103
Hampton Creek, Va.	354,460	992
Harlem River, N.Y.	1,828,562	4,490
Hellens Creek, Md.	55	(1)
Herring Bay and Rockhold Creek, Md.	154	(1)
Herring Creek, Md.	17,940	31
Honga River and Tar Bay, Md.	5,155	21
Hoskins Creek, Va.	7,068	7
Housatonic River, Conn.	880,737	4,404
Hudson River, N.Y. and N.J.:		
Deep Water in Upper Bay, N.Y., to Waterford, N.Y. (net)	39,392,594	1,910,814
Mouth of Spuyten Duyvil Creek (Harlem River) to Waterford, N.Y.	19,062,102	1,511,933
Hudson River Channel, N.Y. and N.J.	36,249,413	398,882
Hull Creek, Va.	444	2
Indian River Inlet and Bay, Del.[2]		
Inland Waterway between Rehoboth Bay and Delaware Bay, Del.	10,288	113
Inland Waterway from Delaware River to Chesapeake Bay, Del. and Md.—Chesapeake and Delaware Canal	8,899,346	409,370
Intracoastal Waterway:		
Jacksonville to Miami, Fla.	669,789	40,958
Miami to Key West, Fla.	234,031	3,631
Ipswich River, Mass.	323	1
Jackson Creek, Va.	191	(1)
Jamaica Bay, N.Y.	5,338,944	64,067
James River, Va.	5,186,222	326,732
Jones Inlet, N.Y.	1,433	3
Josias River, Maine	90	(1)
Kennebec River, Maine	164,409	4,031
Kennebunk River, Maine	5,077	5
Kings Creek, Northampton County, Va.	16,258	16
Knapps Narrows, Md.	7,257	10
Knobbs Creek, N.C.	9,682	5
La Trappe River, Md.	6,170	22
Lake Crescent and Dunns Creek, Fla.	25	(1)
Lake Ogleton, Md.[2]		
Leipsic River, Del.[2]		
Little Machipongo River, Va.	30,867	62
Lemon Creek, Staten Island, N.Y.	1,521	1
Little Creek, Queen Annes County, Md.	3,520	1
Little River, Del.	30	(1)
Little River (Creek), Va.	61,347	61
Little Wicomico River, Va.	4,116	8
Locklies Creek, Va.	11,222	17
Lockwoods Folly River, N.C.	906	2
Long Island Intracoastal Waterway, N.Y.	2,732	93
Lower Entrance Channels, New York Harbor, N.Y.	92,032,671	920,327
Lower Machodoc Creek, Va.	8,523	13
Lower Thoroughfare at or near Wenona, Deal Island, Md.	1,319	1
Lubec Channel, Maine	150,766	265
Mackay Creek, N.C.	158	(1)
Malden River, Mass.	34,143	34
Manasquan River, N.J.	61,010	92
Manhasset Bay, N.Y.	564,422	790
Manokin River, Md.	631	3
Mantua Creek, N.J.	207,709	208
Matawan Creek, N.J.[2]		
Mattaponi River, Va.	52,236	999
Maurice River, N.J.	5,550	39
Meherrin River, N.C.	7,013	74
Merrimack River, Mass.[2]		
Miami River, Fla.	575,692	1,928
Mianus River and Cos Cob Harbor, Conn.	15,780	16

See footnotes at end of table.

Table B-5. Commerce on Project Waterways, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton-miles (000 omitted)
ATLANTIC COAST—Continued		
Middle River and Dark Head Creek, Md.	320	1
Milford Haven, Va.	2,028	2
Mill Creek, Md.	37	(1)
Mill Creek, Va.	121	(1)
Mingo Creek, S.C.[2]		
Mispillion River, Del.	17,079	205
Mulberry Creek, Va.	1,660	1
Murderkill River, Del.	161	(1)
Mystic River, Conn.	17	(1)
Mystic River, Mass.	5,337,173	5,106
Nandua Creek, Va.	1,378	6
Nansemond River, Va.	407,369	3,381
Nanticoke River (including Northwest Fork), Del., and Md.	310,071	11,892
Narrows of Lake Champlain, N.Y. and Vt.	1,162,307	15,691
Neale Sound, Md.	311	(1)
Neponset River, Mass.[2]		
Neuse River, N.C.	275,686	2,757
New Jersey Intracoastal Waterway	294,964	1,770
New River, Fla.	408	2
New York and New Jersey Channels, N.Y. and N.J.	108,488,321	1,989,480
New York State Barge Canal System, N.Y.	3,415,095	452,510
Newark Bay, N.J.	21,427,354	85,847
Newport News Creek, Va.	201,289	81
Newtown Creek, N.Y.	8,374,287	25,123
Nomini Bay and Creek, Va.	8,243	25
Northeast (Cape Fear River), N.C.	1,134	28
Northeast River, Md.	1,242	6
Occohannock Creek, Va.	1,552	6
Occoquan Creek, Va.	17,545	53
Ocmulgee River, Ga.[2]		
Oconee River, Ga.[2]		
Oklawaha River, Fla.	76	(1)
Oldmans Creek, N.J.[2]		
Onancock River, Va.	32,320	178
Orowoc Creek, N.Y.	1,831	2
Otter Creek, Vt.[2]		
Oyster Channel, Va.	23,998	22
Pagan River, Va.	13,512	54
Palm Beach, Fla., side channel and basin[2]		
Pamlico and Tar Rivers, N.C.	59,641	835
Pamunkey River, Va.[2]		
Parish Creek, Md.	2,151	2
Parrotts Creek, Va.	6,192	5
Passaic River, N.J.	10,138,719	76,040
Patchogue River, N.Y.	210,201	158
Patuxent River, Md.	173,718	1,139
Pawcatuck River, R.I. and Conn.	3,570	24
Peconic Bay and River, N.Y.	1,720	3
Penobscot River, Maine	1,230,761	31,692
Perquimans River, N.C.	9,589	105
Pocomoke River, Md.	76,807	2,304
Potomac River below Washington, D.C.	4,378,148	230,779
Potomac River, Virginia Channel	1,023,517	4,811
Potomac River, Washington Channel, D.C.	23	(1)
Quinby Creek, Va.	6,166	5
Raccoon Creek, N.J.	4,411	40
Rahway River, N.J.	66,752	154
Rancocas River, N.J.[2]		
Rappahannock River, Va.	513,359	35,476
Raritan River, N.J.	10,049,918	45,048
Raritan River to Arthur Kill Cut-Off Channel, N.J.	5,181,890	5,182
Rhodes Point to Tylerton, Somerset County, Md.	283	(1)
Rice Creek, Fla.	79,887	264
Roanoke River, N.C.	419,502	8,587
Rollinson Channel, N.C.	6,959	21
Russell Creek, S.C.[2]		
Saco River, Maine	146	1
St. Catherines Sound, Md.	1,494	2
St. Croix River, Maine	30,687	486
St. Jerome Creek, Md.	613	1
St. Johns River, Fla., Jacksonville to Lake Harney	569,064	33,521
St. Jones River, Del.[2]		
St. Lucie Inlet, Fla.	262	1

See footnotes at end of table.

Table B–5. Commerce on Project Waterways, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton-miles (000 omitted)
ATLANTIC COAST—Continued		
St. Marys River, Ga., and Fla	96,619	580
St. Patricks Creek, Md	1,095	1
Sakonnet River and Harbor, R.I.[2]		
Salem River, N.J	43,300	173
Sandy Hook Bay, N.J	117,289	53
Santee River, S.C	2,000	154
Satilla River, Ga	40,767	1,305
Savannah River below Augusta, Ga	63,073	12,362
Schuylkill River, Pa	13,259,520	53,038
Scuppernong River, N.C	5,699	28
Seekonk River, R.I	199,675	399
Shallotte River, N.C	1,171	1
Shark River, N.J.[2]		
Sheepshead Bay, N.Y	81,858	25
Shipyard River, S.C	922,139	922
Shoal Harbor and Compton Creek, N.J	72,744	18
Shrewsbury River, N.J.[2]		
Slaughter Creek, Md	225	(1)
Smith Creek, Md	2,998	4
Smiths Creek (Pamlico County), N.C	940	1
Smiths Creek (Wilmington), N.C	6,064	6
Smyrna River, Del.[2]		
South River, N.C	7,160	21
Starlings Creek, Va	29,124	17
Stumpy Point Bay, N.C	1,134	2
Susquehanna River above and below Havre de Grace, Md	15,818	79
Swift Creek, N.C.[2]		
Tangier Channel, Va	4,046	5
Taunton River, Mass.[2]		
Thames River, Conn	690,935	11,365
Toms River, N.J.[2]		
Totuskey Creek, Va	29,918	165
Town Creek, Md	2,538	1
Town River, Mass	821,614	616
Tred Avon River, Md	91,456	915
Trent River, N.C	7,435	11
Tuckerton Creek, N.J	1,027	3
Twitch Cove and Big Thoroughfare River, Md	5,927	30
Tyaskin Creek, Md	8	(1)
Union River, Maine[2]		
Upper Bay, N.Y. and N.J	128,637,139	714,110
Upper Machodoc Creek, Va	126	(1)
Upper Thoroughfare, Deal Island, Md	8,666	5
Urbanna Creek, Va	15,149	8
Waccamaw River, N.C. and S.C	10,703	444
Wallabout Channel, N.Y	244,409	49
Wallace Channel, Pamlico Sound, N.C	4,866	34
Wappinger Creek, N.Y.[2]		
Warren River, R.I	1,036	1
Warwick River, Md	10,600	16
Washington Canal and South River, N.J	98,152	334
Waterway connecting Pamlico Sound and Beaufort Harbor, N.C	9,901	178
Waterway connecting Swan Quarter Bay with Deep Bay, N.C	700	2
Waterway from Indian River Inlet to Rehoboth Bay, Del	646	1
Waterway on the coast of Virginia	83,599	1,418
Waycake Creek, N.J.[2]		
Westchester Creek, N.Y	1,391,126	2,782
Weymouth Back River, Mass	43,370	22
Weymouth Fore River, Mass	2,276,795	12,687
Whitings Creek, Va	144	(1)
Wicomico River, Md. (Eastern Shore)	482,583	14,311
Willoughby Channel, Va.[2]		
Wilmington Harbor, N.C. (see also Port of Wilmington, N.C., for port data)	5,168,062	121,985
Woodbridge Creek, N.J	49,509	7
Woodbury Creek, N.J.[2]		
Woods Hole Channel, Mass	35,955	32
York River, Va	5,213,739	119,916

See footnotes at end of table.

Table B–5. Commerce on Project Waterways, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton-miles (000 omitted)
GULF COAST		
Alabama-Coosa Rivers, Ala. and Ga.	775,260	46,711
Amite River and Bayou Manchac, La.	14,504	388
Anahuac Channel, Texas	1,071,580	5,144
Anclote River, Fla.	1,360	12
Apalachicola, Chattahoochee and Flint Rivers, Ga. and Fla.	404,473	35,358
Atchafalaya River, La., Morgan City to Gulf of Mexico	3,181,643	90,798
Barataria Bay Waterway, La.	1,815,146	47,022
Bayous:		
Bastrop, Tex.[2]		
Bernard, Miss.	17,040	54
Big Pigeon and Little Pigeon, La.	174,074	2,437
Bonfouca, La.	18,223	164
Casotte, Miss.	230,897	901
Cedar, Tex.	227,893	1,047
Chico, Fla.	127,633	143
Chocolate, Tex.	150,752	2,307
Coden, Ala.	2,349	2
Dickinson, Tex.	432,272	3,673
Double, Tex.	58,261	180
Dupre, La.	699	4
Galere, Miss.[2]		
Grosse Tete, La.	39,939	450
Johnsons, La.	90,593	453
LaBatre, Ala.	20,497	50
Lacombe, La.	48,009	226
Lafourche, La.	2,308,356	32,155
LaGrange, Fla.	246,180	987
LaLoutre, St. Malo, and Ysclosky, La.	7,339	158
Little Caillou, La.	59,256	1,050
Petit Anse, Tigre, and Carlin, La.	876,821	6,649
Plaquemine Brule, La.	23,399	296
Queue de Tortue, La.[2]		
Segnette, La.	5,194	18
Teche, La.	491,203	19,999
Terrebonne, La.	1,791,558	19,282
Vermilion, La.	707,792	9,232
Watson, Fla.	141,299	177
Black Warrior, Warrior, and Tombigbee Rivers, Ala.	5,804,107	1,579,117
Blackwater River, Fla.	11,121	133
Bluff Creek, Miss.	2,437	19
Brazos Island Harbor, Tex. (Waterway)	1,414,988	17,853
Calcasieu River and Pass, La.	17,433,441	378,237
Channel from Naples, Fla., to Big Marco Pass, Fla.	14,217	164
Channel from Pass Cavallo to Port Lavaca, Texas	2,037,369	32,037
Channel to Aransas Pass, Tex.	97,001	564
Channel to Palacios, Tex.	140,844	1,956
Channel to Port Bolivar, Tex.	2,031	2
Channel to Rockport, Tex.	5,701	13
Chefuncte and Bogue Falia Rivers, La.	70,890	148
Chickasaw Creek, Ala.	877,310	1,389
Choctawhatchee River, Fla. and Ala.[2]		
Clear Creek, Tex.	135,689	1,588
Crystal River, Fla.	304	3
Cypress Bayou and Waterway between Jefferson, Tex., and Shreveport, La.	95	1
East Pass Channel from the Gulf of Mexico into Choctawhatchee Bay, Fla.	829	1
East Pearl River, Miss.	33,260	439
Escambia and Conecuh Rivers, Fla. and Ala., Escambia Bay, Fla.	389,434	8,214
Franklin Canal, La.	1,903	10
Grand Bayou Pass, La.[2]		
Guadalupe River to Victoria, Tex.	252,504	2,869
Gulf County Canal, Fla.	56,372	286
Gulf Intracoastal Waterway:		
Between Apalachee Bay, Fla., and the Mexican border	54,948,389	8,340,471
Plaquemine to Morgan City Route, La.	2,773,826	119,949
Homosassa River, Fla.	363	2
Horseshoe Cove, Fla.	609	1
Hudson River, Fla.[2]		
Inland Waterway from Franklin to Mermentau River, La.	481,694	8,706
Innerharbor Navigation Canal, La.	6,003,529	23,460
Intracoastal Waterway, Caloosahatchee River to Anclote River, Fla.	261,330	7,191
Kissimmee River, Fla.	143	1
Lake Charles Deep Water Channel, La.	19,482,584	4,851,163
Little Manatee River, Fla.	550	2
Manatee River, Fla.	22,032	44

See footnotes at end of table.

Table B–5. Commerce on Project Waterways, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton-miles (000 omitted)
GULF COAST—Continued		
Mermentau River, Bayou Nezpique and Bayou Des Cannes, La	3,024,020	81,218
Okeechobee Waterway, Fla	330,167	5,877
Ozona, Fla., channel and turning basin	1,165	1
Pascagoula River, Miss	6,327	131
Pass Manchac, La	212,829	1,490
Pearl River, Miss. and La	387,344	13,658
Pithlachascotee River, Fla.[2]		
Port Aransas (Aransas Pass)—Corpus Christi Waterway, Tex	24,840,443	446,597
Port Mansfield, Tex. (tributary)	114,799	883
Sabine-Neches Waterway, Tex	68,693,211	1,554,056
St. Marks River, Fla	410,212	2,904
San Bernard River, Tex	840,223	20,293
Steinhatchee River, Fla	523	3
Suwannee River, Fla	553	3
Terrebonne Bay, La.[2]		
Three Mile Creek, Ala	4,298,454	1,415
Tickfaw, Natalbany, Ponchatoula, and Blood Rivers, La	73,693	884
Tributary Arroyo Colorado, Tex	215,100	5,180
Trinity River, Channel to Liberty, Tex	965,416	10,538
Upper Chipola River, Fla., from mouth to Marianna[2]		
Vinton Waterway, La	44,923	449
Waterway connecting the Tombigbee and Tennessee Rivers, Ala. and Miss.[2]		
Waterway from Empire, La., to Gulf of Mexico	511,413	4,080
Waterway from Intracoastal Waterway to Bayou Dulac, La. (Bayous Le Carpe and Grand Caillou)	430,223	5,759
Waterway from White Lake to Pecan Island, La	46,288	83
Withlacoochee River, Fla	63,753	573
Wolf and Jordan Rivers, Miss	25,355	304
PACIFIC COAST		
Bodega Bay, Calif	2,518	3
Canals and Locks at Willamette Falls, Oreg	1,091,982	328
Chinook Channel, Wash	171	(1)
Clatskanie River, Oreg	16,649	58
Columbia River:		
Mouth to International Boundary (net)	22,152,906	1,777,916
At Baker Bay, Wash	452	2
Columbia and Lower Willamette Rivers below Vancouver, Wash., and Portland, Oreg	21,866,626	1,470,039
At Bonneville, Oreg	2,316,362	2,316
At McNary Lock and Dam, Oreg., and Wash	1,381,436	1,105
Between Wenatchee and Kettle Falls, Wash	219,416	6,007
Vancouver, Wash., to The Dalles, Oreg	4,349,281	200,740
The Dalles Dam, Oreg., and Wash	1,857,849	242
Columbia River and tributaries above The Dalles Dam to McNary Lock and Dam, Oreg. and Wash	2,704,426	160,728
Columbia River and tributaries above McNary Lock and Dam to Kennewick, Wash	1,401,898	24,744
Columbia Slough, Oreg	13,763	76
Coos and Millicoma Rivers, Oreg	923,936	4,158
Coquille River, Oreg	522,108	4,960
Coquille River, Oreg. (entrance)	231,518	272
Cowlitz River, Wash	142,797	585
Deep River, Wash	439,470	2,197
Elokomin Slough, Wash	214,250	214
Flathead Lake, Montana[2]		
Gastineau Channel, Alaska[2]		
Grays River, Wash	3,788	19
Hoquiam River, Wash	642,558	5,140
Kootenai River, Idaho and Mont.[2]		
Lake River, Wash	4,070	7
Lake Washington Ship Canal, Wash	1,995,119	(2)
Lewis River, Wash	118,097	757
Middle River and connecting channels, Calif	8,336	60
Mokelumne River, Calif	39,248	314
Multnomah Channel, Oreg	943,499	5,661
Napa River, Calif	13,305	206
Nehalem Bay, Oreg.[2]		
Noyo River, Calif	3,452	4
Old River, Calif	170,536	5,213
Petaluma Rver, Calif	234,749	4,578
Quillayute River, Wash	364	(1)
Rogue River, Oreg	15	(1)
Sacramento River, Calif	2,120,899	124,816

See footnotes at end of table.

Table B–5. Commerce on Project Waterways, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton-miles (000 omitted)
PACIFIC COAST—Continued		
San Joaquin River, Calif.	4,466,555	148,566
San Pablo Bay and Mare Island Strait, Calif.	2,622,693	(3)
San Rafael Creek, Calif.[2]		
Siuslaw River, Oreg.	289,156	2,024
Skagit River, Wash.	41,108	452
Skamokawa Creek, Wash.	25,334	8
Skamokawa Steamboat Slough, Wash.	20,289	5
Skipanon Channel, Oreg.	133,124	242
Smith River, Oreg.	294,283	1,766
Snake River, Oreg., Wash, and Idaho	643,288	970
Stillaguamish River, Wash.	2,424	15
Suisun Bay Channel, Calif.	9,870,963	94,946
Suisun Channel, Calif.	279,001	3,627
Swinomish Slough, Wash.	388,337	2,689
Umpqua River, Oreg.	807,933	8,887
Waterway connecting Port Townsend and Oak Bay, Wash.	424,322	382
Westport Slough, Oreg.	1,500	1
Willamette River above Portland and Yamhill River, Oreg.	4,064,710	64,613
Wrangell Narrows, Alaska	276,606	6,058
Yaquina River, Oreg.	715,368	6,438
Youngs Bay and Youngs River, Oreg.	1,001,020	3,504
GREAT LAKES		
Big Suamico River, Wis.	105	(3)
Calumet-Sag Channel, Ill.	5,242,500	110,791
Channels in Lake St. Clair, Mich.	96,552,628	(5)
Chicago River (Main and North Branch), Ill.	3,940,346	7,454
Chicago River (South Branch), Ill.	5,619,590	20,986
Chicago Sanitary and Ship Canal, Ill.	19,966,596	363,941
Clinton River, Mich.[2]		
Detroit River, Mich.	111,165,158	3,070,820
Grand River, Mich.	1,638,564	24,578
Grays Reef Passage, Mich.	5,239,454	(3)
Keeweenaw Waterway, Mich.	473,846	(3)
Lake Calumet, Ill.	1,167,021	(3)
Niagara River, N.Y.	3,357,251	(3)
Rouge River, Mich.	11,579,646	(3)
Saginaw River, Mich.	5,575,660	(3)
St. Clair River, Mich.	97,192,281	5,475,910
St. Joseph River, Mich.	33,550	235
St. Marys Falls Canal, Mich. (U.S. Canal)	89,698,967	(3)
St. Marys River, Mich.	95,434,888	5,225,808
Sturgeon Bay and Lake Michigan Ship Canal, Mich.	1,046,726	(5)
MISSISSIPPI RIVER SYSTEM		
Allegheny River, Pa., improved portion	3,832,781	58,415
Allegheny River, Pa., open channel portion	99,700	100
Arkansas River, Ark. and Okla.	813,173	4,829
Atchafalaya River, La.	6,067,469	677,785
Bayous:		
Bartholomew, La. and Ark.[2]		
D'Arbonne and Corney, La.[2]		
Big Sandy River, Tug and Levisa Forks, Ky. and W. Va.	65,890	264
Big Sunflower River, Miss.[2]		
Black River, Ark. and Mo.[2]		
Black River, Wis.	355,802	302
Boeuf River, La.[2]		
Cumberland River, mouth to Burnside, Ky. (net)	2,814,766	396,902
Mouth to Nashville, Tenn.	2,814,766	395,909
Nashville, Tenn., to Burnside, Ky.	41,147	993
French Broad and Little Pigeon Rivers, Tenn.	42,425	354
Green and Barren Rivers, Ky.	5,446,365	470,824
Illinois and Mississippi Canal, Ill.[2]		
Illinois River, Ill.	22,807,633	4,555,426
Kanawha River, W. Va.	10,079,841	558,381
Kentucky River, Ky.	399,633	28,370
Little Kanawha River W. Va.	218,317	597
Little River, La.[2]		
Little Sunflower River, Miss.[2]		
Minnesota River, Minn.	1,367,502	15,499

See footnotes at end of table.

Table B–5. Commerce on Project Waterways, Calendar Year 1960—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton-miles (000 omitted)
MISSISSIPPI RIVER SYSTEM—Continued		
Mississippi River:		
Minneapolis, Minn., to mouth of Passes (net)	128,347,795	40,262,533
Minneapolis, Minn., to mouth of Missouri River	27,393,934	4,852,705
Mouth of Missouri River to Mouth of Ohio River	30,021,316	4,430,056
Mouth of Ohio River to but not including Baton Rouge, La	40,149,540	20,754,018
Baton Rouge, La., to but not including New Orleans, La	52,354,701	4,597,963
New Orleans, La., to mouth of Passes	79,813,281	5,627,791
Gulf Outlet, La	178,746	7,254
Missouri River:		
Fort Benton to the mouth (net)	6,948,875	686,412
Kansas City to the mouth	4,034,472	547,589
Omaha to Kansas City	2,356,021	130,290
Sioux City to Omaha	907,615	4,481
Fort Benton to Sioux City	352,928	4,052
Monongahela River, Pa. and W. Va	29,532,592	1,421,497
Mouth of Yazoo River, Miss	542,095	1,131
Muskingum River, Ohio	31,904	6
Ohio River, Pittsburgh to mouth	79,477,596	17,704,282
Ouachita and Black Rivers, Ark. and La	495,376	71,514
Ouachita River above Camden, Ark.[2]		
Red River below Fulton, Ark	305,816	8,471
Rough River, Ky.[2]		
St. Croix River, Wis., and Minn	43,145	988
St. Francis and L'Anguille Rivers and Blackfish Bayou, Ark	2,450	44
Saline River, Ark.[2]		
Steele and Washington Bayous and Lake Washington, Miss.[2]		
Tallahatchie and Coldwater Rivers, Miss.[2]		
Tennessee River, Tenn., Ala., and Ky	12,440,696	2,312,735
Tensas River and Bayou Macon, La.[2]		
Tradewater River, Ky	26,708	80
Upper White River, Ark	35,100	176
White River, Ark., below Batesville, Ark	315,172	10,734
Wolf River, Tenn	825,490	1,442
Yazoo River, Miss	90,091	1,892
Youghiogheny River, Pa	103,488	21
OTHER WATERWAYS		
Fox River, Wis.[2]		
St. Joseph River, Mich	33,550	235

[1] Less than 500 ton-miles.
[2] No commerce reported.
[3] Ton-miles not reported.
[4] Included in Delaware River, Philadelphia, Pa., to the sea.
[5] Included in St. Clair River.

APPENDIX C

FLOOD CONTROL

Table C–1. Flood Control Projects

(As of June 30, 1961)

Region	Reservoirs	Local protection	General authorizations	Flood damages prevented ($ millions)	
				Fiscal year 1961	Cumulative through fiscal year 1961
Alaska		5		0.2	2
Arkansas-Red-White	28	55	3	22.9	244
Central Valley	11	5		Minor	550
Colorado	5	1		Minor	Minor
Columbia	11	78	17	43.2	244
Great Basin		1		Minor	Minor
Great Lakes and St. Lawrence	5	12	5	1.7	17
Hawaii		2	1	Minor	Minor
Lower Mississippi	5	18		708.4	6,758
Missouri	13	60	11	3.5	1,030
New England	20	23	8	0.2	148
North Atlantic	13	34	10	16.4	179
North Pacific	1	14	8	0.3	5
Ohio	39	66	11	20.9	720
Souris and Red	5	13	6	Minor	7
South Atlantic and East Gulf	[1] 3	27	13	29.8	94
South Pacific	11	14	3	Minor	174
Upper Mississippi	11	85	3	4.6	212
West Gulf	11	12	5	16.3	206
Total	192	525	[2] 104	868.4	10,590

[1] Does not include the Central and Southern Florida project.
[2] These 104 projects are included in the 525 shown in the preceding column.

NOTE.—The reservoirs are those completed or in partial operation and include reservoirs funded by the Corps and operated by others.

Table C-2. Flood Control Reservoirs Operable June 30, 1961

Nomenclature for Project Functions

A—Low Flow Augmentation
F—Flood Control
I—Irrigation
N—Navigation
R—Public Recreation (annual public attendance exceeding 5,000)
S—Water Supply
W—Fish and Wildlife (Federal or State)
X—Water Conservation and Sedimentation

Name of dam and reservoir	River basin	Stream	Community in vicinity	Calendar year placed in useful operation	Total storage (acre-feet)	Permanent pool* (acreage) or no pool (NPP)	Project functions	Characteristics of dam		
								Type	Height (feet)	Length (feet)
Arizona:										
Painted Rock	Colorado	Gila River	Gila Bend	1959	2,491,700	100	FRWX	Earth	181	4,796
Whitlow Ranch	do	Queen Creek	Superior	1960	35,890	NPP	FRWX	do	149	837
Trilby Wash Basin (McMicken Dam).	do	Trilby Wash	Phoenix	1956	19,300	NPP	F	do	34	50,200
Arkansas:										
Blue Mountain	Arkansas	Petit Jean River	Paris	1947	258,000	2,900	FRWX	do	115	2,800
Nimrod	do	Fourche La Fare River	Danville	1942	336,000	3,600	FRWX	Concrete	97	1,012
California:										
Brea Dam	Santa Ana	Brea Creek	Fullerton	1942	4,100	NPP	FRX	Earth	87	1,765
Carbon Canyon	do	Carbon Creek	Brea	1961	7,050	NPP	FRX	do	99	2,610
Coyote Valley	Russian	East Fork of Russian River	Ukiah	1959	122,500	1,700	FRX	do	160	3,500
Farmington	San Joaquin	Littlejohn Creek	Farmington	1951	52,000	NPP	F	do	58	7,800
Fullerton	Santa Ana	East Fullerton Creek	Fullerton	1941	743	NPP	FRX	do	47	575
Hansen	Los Angeles	Big Tujunga Wash	Los Angeles	1940	33,500	100	FRX	do	97	10,475
Isabella	San Joaquin	Kern River	Bakersfield	1953	570,000	1,850	FRX	do	185	4.982
Lopez	Los Angeles	Pacoima Wash	San Fernando	1954	209	NPP	FX	do	50	1,300
Merced County Stream Group:										
Bear Dam	San Joaquin	Bear Creek	Merced	1954	7,700	NPP	F	do	92	1,830
Burns Dam	do	Burns Creek	do	1950	7,000	NPP	F	do	55	4,070
Mariposa Dam	do	Mariposa Creek	do	1948	15,000	NPP	F	do	88	1.330
Owens Dam	do	Owens Creek	do	1949	3,600	NPP	F	do	75	790
Pine Flat	do	Kings River	Piedra	1954	1,000,000	NPP	FRX	Concrete	429	1,820
Prado	Santa Ana	Santa Ana River	Corona	1941	217,000	NPP	FRX	Earth	106	2,280
San Antonio	do	San Antonio Creek	Pomona	1956	9,285	NPP	FRX	do	160	3,850
Santa Fe	San Gabriel	San Gabriel River	Duarte	1949	34,000	NPP	F	do	92	23,800
Sepulveda	do	Los Angeles River	Los Angeles	1941	17,440	6,260	FX	do	57	15,443
Success	San Joaquin	Tule River	Porterville	1961	80,000	400	FRX	do	142	3,490
Whittier Narrows	San Gabriel	San Gabriel River	El Monte	1957	36,160	7,840	FX	do	56	16,960
Colorado:										
Cherry Creek	Missouri	Cherry Creek	Denver	1950	96,000	880	FRX	do	140	14,300
John Martin	Arkansas	Arkansas River	Lamar	1942	645,500	12,145	FIRX	Concrete	130	1,174

Table C-2. Flood Control Reservoirs Operable June 30, 1961—Continued

Name of dam and reservoir	River basin	Stream	Community in vicinity	Calendar year placed in useful operation	Total storage (acre-feet)	Permanent pool* (acreage) or no pool (NPP)	Project functions	Characteristics of dam		
								Type	Height (feet)	Length (feet)
Connecticut:										
Mansfield Hollow	Thames	Natchaug River	Willamantic	1952	52,000	NPP	FRW	Earth	70	12,422
Thomaston	Housatonic	Naugatuck River	Thomaston	1960	42,000	NPP	FRW	do	142	2,000
Idaho: Lucky Peak	Columbia	Boise River	Boise	1956	307,000	2,850	FIR	do	238	1,700
Illinois:										
Farm Creek Reservoirs:										
Fondulac Dam	Upper Mississippi	Fondulac Creek	Peoria	1954	3,780	NPP	F	do	67	1,000
Farmdale Dam	do	Farm Creek	do	1954	15,500	NPP	F	do	80	1,275
Indiana:										
Cagles Mill	Ohio	Mill Creek	Terre Haute	1953	228,120	1,400	FRX	do	150	950
Mansfield	do	Raccoon Creek	Rockville	1960	132,800	1,100	FRX	do	117	1,790
Iowa: Coralville	Upper Mississippi	Iowa River	Iowa City	1958	492,000	1,820	FAR	do	100	1,400
Kansas:										
Fall River	Arkansas	Fall River	Fall River	1949	263,000	2,600	FARWX	do	94	6,015
Kanopolis	Missouri	Smoky Hill River	Salina	1948	450,000	3,600	FRWX	do	131	15,360
Toronto	Arkansas	Verdigris River	Toronto	1960	195,300	2,800	FARWX	do	90	4,712
Tuttle Creek	Missouri	Big Blue River	Manhattan	1960	2,346,000	10,800	FRWX	do	157	7,500
Kentucky:										
Buckhorn	Ohio	Middle Fork of Kentucky River.	Buckhorn	1960	168,000	550	FR	do	162	1,020
Dewey	do	Johns Creek	Paintsville	1950	93,000	880	FARW	do	118	913
Rough River	do	Rough River	Leitchfield	1958	334,400	1,700	FRX	do	124	1,530
Louisiana:										
Bayou Bodcau	Red	Bayou Bodcau	Shreveport	1949	357,000	NPP	FR	do	76	11,800
Wallace Lake	do	Cypress Bayou	do	1946	96,100	2,300	FR	do	46	4,940
Massachusetts:										
Barre Falls	Connecticut	Ware River	Barre	1958	24,000	NPP	FRW	do	62	885
Birch Hill	do	Millers River	South Royalton	1941	49,900	NPP	FRW	do	56	1,400
Buffumville	do	Little River	Charlton	1958	12,700	200	FRW	do	66	3,255
East Brimfield	Thames	Quinebaugh River	Fiskdale	1960	30,000	300	FRW	do	55	520
Hodges Village	do	French River	Oxford	1959	12,800	NPP	FRW	do	55	2,140
Knightville	Connecticut	Westfield River	Huntington	1941	49,000	NPP	FRW	do	160	1,200
Tully	do	Tully River	Fryville	1949	22,000	NPP	FRW	do	62	1,570
West Hill	Blackstone	West River	Uxbridge	1961	12,350	NPP	FW	do	51	2,400
Minnesota:										
Lac Qui Parle Project:										
Chippewa River	Upper Mississippi	Chippewa River	Montevideo	1950 [1]	(2)		FRWX	do	23.3	17,97$_5$

See footnotes at end of table.

Lac Qui Parle	do	Minnesota River	do	1950 [1]	(121,500)	6,500	FRWX	do	21	3,800
Marsh Lake	do	do	do	1950 [1]	35,000	4,500	FRWX	do	19.5	11,800
Orwell	Red River of the North.	Otter Tail River	Fergus Falls	1953	14,100	210	FARS	do	47	1,355
Red Lake	do	Red Lake River	Red Lake	1951 [1]	2,680,000	277,560	FARSX	do	15.5	36,500
Mississippi:										
Sardis	Lower Mississippi	Little Tallahatchie River	Sardis	1940	1,570,000	9,800	FR	do	118	15,300
Arkabutla	do	Coldwater River	Arkabutla	1943	525,300	5,100	FR	do	87	10,000
Enid	do	Yocona River	Enid	1951	660,000	6,100	FR	do	100	8,400
Grenada	do	Yalobusha River	Grenada	1954	1,337,400	9,800	FR	do	96	13,900
Missouri:										
Clearwater	White	Black River	Piedmont	1948	413,000	1,630	FRWX	do	154	4,225
Pomme de Terre	Missouri	Pomme de Terre R.	Hermitage	1960	650,000	1,040	FNRW	do	155	4,630
Wappapello	Lower Mississippi	St. Francis River	Wappapello	1941	625,000	5,200	FR	do	109	2,700
Nebraska:										
Harlan County	Missouri	Republican River	Republican City	1952	850,000	13,600	FIRWX	do	107	11,827
Nevada:										
Mathews Canyon	Colorado	Mathews Canyon	Caliente	1957	6,260	NPP	FX	do	71	800
Pine Canyon	do	Pine Canyon	do	1957	7,840	NPP	FX	do	92	884
New Hampshire:										
Blackwater	Merrimack	Blackwater River	Webster	1941	46,000	NPP	FRW	do	75	1,150
Edward MacDowell	do	Nubanusit Brook	West Peterborough.	1950	12,800	NPP	FRW	do	67	1,030
Franklin Falls	do	Pemigewasset River	Franklin	1943	154,000	NPP	FRW	do	140	1,740
Otter Brook	Connecticuit	Otter Brook	Keene	1958	18,300	100	FRW	do	133	1,288
Surry Mountain	do	Ashuelot River	do	1941	32,500	300	FRW	do	86	1,670
New Mexico:										
Abiquiu	Rio Ganade	Rio Chamo River	Abiquiu	1960	562,000	NPP	F	do	325	1,540
Conchas	Arkansas	Canadian River	Tucumcari	1939	566,200	9,594	FRX	Concrete	200	1,250
Jemez Canyon	Rio Grande	Jemez River	Bernalillo	1953	120,000	NPP	FRX	Earth	136	780
New York:										
Almond	Susquehanna	Canacadea Creek	Hornell	1949	22,750	NPP	F	do	90	1,260
Arkport	do	Canisteo Creek	do	1939	10,830	NPP	F	do	113	1,200
East Sidney	do	Ouleout Creek	Sidney	1950	58,300	NPP	F	Concrete and earth.	146	2,000
Mount Morris	Genesee	Genesee River	Mount Morris	1952	337,000 %	170	FR	Concrete	215	1,028
Onondaga Dam	Oswego	Onondaga Creek	Syracuse	1949	18,200	NPP	F	Earth	67	1,782
Whitney Point	Susquehanna	Otselie River	Binghamton	1942	146,250	NPP	F	do	95	4,900
North Dakota:										
Bald Hill	Red River of the North.	Sheyenne River	Valley City	1950	70,700	325	FARS	do	61	1,650
Homme	do	South Branch of Park River.	Park River	1950	3,650	51	FARS	do	67	865
Ohio:										
Berlin	Ohio	Mahoning River	Deerfield	1943	91,200	200	FARSW	Earth and concrete.	96	5,750
Delaware	do	Olentangy River	Delaware	1951	132,000	950	FARWX	Earth	92	18,600
Dillon	do	Licking River	Zanesville	1961	273,800	1,325	FRWX	do	118	1,400
Mosquito Creek	do	Mosquito Creek	Cortland	1944	104,100	700	FARSW	do	47	5,650
Tom Jenkins	do	East Branch, Sunday Creek.	Gloucester	1951	26,900	394	FRSWX	do	84	944
West Fork Mill Creek.	do	Mill Creek	Mount Healthy	1952	11,380	200	FRX	do	100	1,100

Table C-2. Flood Control Reservoirs Operable June 30, 1961—Continued

Name of dam and reservoir	River basin	Stream	Community in vicinity	Calendar year placed in useful operation	Total storage (acre-feet)	Permanent pool* (acreage) or no pool (NPP)	Project functions	Characteristics of dam		
								Type	Height (feet)	Length (feet)
Muskingum River Dams: [3]										
Atwood	Ohio	Indian Fork	New Cumberland	1937	49,700	1,540	FRX	Earth	65	3,700
Beach City	do	Sugar Creek	Beach City	1937	71,700	420	FRX	do	64	5,600
Bolivar	do	Sandy Creek	Bolivar	1938	149,600	NPP	FR	do	87	6,300
Charles Mill	do	Black Fork	Mifflin	1936	88,000	1,350	FRX	do	48	1,390
Clendening	do	Brushy Fork	Tippencanoe	1937	54,000	1,800	FRX	do	64	950
Dover	do	Tuscarawas River	Dover	1938	203,000	350	FRX	Concrete	83	824
Leesville	do	McGuire Creek	Leesville	1937	37,400	1,000	FRX	Earth	74	1,695
Mohawk	do	Walhonding River	Nellie	1937	285,000	NPP	FR	do	111	2,330
Mohicanville	do	Lake Fork	Mohicanville	1936	102,000	NPP	FR	do	46	1,220
Piedmont	do	Stillwater Creek	Piedmont	1937	65,000	2,270	FRX	do	56	1,750
Pleasant Hill	do	Clear Fork	Perrysville	1938	87,700	850	FRX	do	113	775
Senecaville	do	Seneca Fork	Senecaville	1937	88,500	3,550	FRSX	do	45	2,350
Tappan	do	Little Stillwater Creek	Tappan	1936	61,600	2,350	FRX	do	52	1,550
Wills Creek	do	Wills Creek	Conesville	1937	196,000	900	FRX	do	87	1,950
Oklahoma:										
Canton	Arkansas	North Canadian River	Canton	1948	386,000	7,700	FRSX	do	73	15,100
Fort Supply	do	Wolf Creek	Woodward	1941	101,800	1,800	FRWX	do	85	11,865
Great Salt Plains	do	Salt Fork of the Arkansas River.	Cherokee	1941	292,000	9,300	FRWX	do	72	6,010
Heyburn (Polecat Creek).	do	Polecat Creek	Sapulpa	1950	59,700	980	FRWX	do	89	2,920
Hulah	do	Caney Fork	Bartlesville	1950	292,500	3,600	FRSWX	do	94	6,315
Oologah	do	Verdigris River	Claremore	1961	1,519,000	29,500	FRSX	do	129	4,000
Wister	do	Poteau River	Wister	1949	430,000	4,000	FRWX	do	99	5,700
Oregon:										
Cottage Grove	Columbia	Coast Fork of Willamette River.	Cottage Grove	1942	32,940	1,158	FINR	do	71	2,110
Dorena	do	Row River	do	1949	77,500	1,835	FINR	do	100	3,297
Fern Ridge	do	Long Tom River	Eugene	1941	101,200	9,360	FINR	do	31.5	6,624
Pennsylvania:										
Bear Creek	Delaware	Lehigh River	Wilkes-Barre	1961	149,000	90	FNRW	do	234	3,000
Conemaugh	Ohio	Conemaugh River	Saltsburg	1952	274,000	300	FRWX	Earth and concrete.	137	1,265
Crooked Creek	do	Crooked Creek	Ford City	1940	93,900	400	FNRX	Earth	143	1,480
East Branch, Clarion River.	do	East Branch, Clarion River.	Wilcox	1952	84,300	100	FARX	do	184	1,725
General Edgar Jadwin (Dyberry).	Delaware	Lackawaxen River	Honesdale	1959	47,300	NPP	F	do	112	1,280
Indian Rock Dam (York).	Susquehanna	Codorus Creek	York	1942	48,000	NPP	F	do	83	1,000
Loyalhanna	Ohio	Loyalhanna Creek	Saltsburg	1942	95,300	200	FRWX	Earth and concrete.	114	960
Mahoning Creek	do	Mahoning Creek	New Bethlem	1941	74,200	200	FRWX	Concrete	162	926
Prompton	Delaware	Lackawaxen River	Honesdale	1960	72,800	280	FNRW	Earth	140	1,230
Stillwater	Susquehanna	Lackawanna River	Forest City	1960	17,000	83	FS	do	77	1,700
Tionesta	Ohio	Tionesta Creek	Tionesta	1941	133,400	500	FRWX	do	154	1,050
York. (See Indian Rock.)										
Youghiogheny River, Ohio.		Youghiogheny River	Confluence	1943	254,000	500	FARWX	do	184	1,610
South Dakota:										
Cold Brook	Missouri	Cold Brook	Hot Springs	1953	7,200	36	FRWX	do	130	925
Lake Traverse Project Reservation Control Dam.	Red River of the North.	Bois de Sioux River	Wheaton	1941	164,500	11,600	FRX	do	145	9,100
White Rock Dam	do	do	do	1941	85,000	4,600	FRX	do	16	14,400
Texas:										
Addicks Dam	San Jacinto	South Mayde Creek	Addicks	1948	204,500	NPP	FX	do	50	61,166
Barker Dam	do	Buffalo Bayou	do	1945	207,000	NPP	FX	do	39	72,844
Belton	Brazos	Leon River	Belton	1954	1,097,600	7,400	FIRSX	do	192	5,524
Benbrook	Trinity	Clear Fork of Trinity River.	Fort Worth	1952	258,600	3,770	FNRX	do	130	9,130
Ferrills Bridge	Red	Cypress Creek	Jefferson	1959	842,100	1,100	FRS	do	97	10,600
Grapevine	Trinity	Denton Creek	Grapevine	1952	435,500	7,380	FNRSX	do	137	12,850
Hords Creek	Colorado (Tex.)	Hords Creek	Coleman	1948	25,130	510	FARSX	do	91	6,300
Lavon	Trinity	East Fork of Trinity River.	Fort Worth	1953	423,400	11,800	FRSX	do	69	9,499
Lewisville	do	Elm Fork of Trinity River.	Lewisville	1954	1,016,200	23,470	FRSX	do	125	32,888
San Angelo	Colorado (Tex.)	North Concho River	San Angelo	1952	396,400	5,440	FRSX	do	128	37,325
Texarkana	Red	Sulphur River	Texarkana	1959	2,654,300	20,300	FRS	do	106	18,500
Vermont:										
Ball Mountain	Connecticut	West River	Jamaica	1961	54,600	NPP	FW	do	265	915
North Hartland	do	Ottauquechee River	North Hartland	1961	71,420	100	FW	do	185	1,520
North Springfield	do	Black River	Springfield	1960	51,067	100	FW	do	120	2,940
Townshend	do	West River	Townshend	1961	33,700	100	FW	do	133	1,700
Union Village	do	Ompompanoosoc River	Union Village	1950	38,000	NPP	FRW	do	170	1,100
Washington:										
Howard A. Hansen	Green	Green River	Kanasket	1961	106,000	1,700	FAS	Rock	196	675
Mill Creek	Columbia	Mill Creek	Walla Walla	1942	6,700	195	FR	Earth	120	3,050
Mud Mountain	Puyallup	White River	Buckley	1953	106,000	1,200	FR	Rock	322	700
West Virginia:										
Bluestone	Ohio	New River	Hinton	1952	631,000	1,860	FRWX	Concrete	180	2,048
Sutton	do	Elk River	Sutton	1960	265,300	270	FARWX	do	220	1,178
Tygart River Dam	do	Tygart River	Grafton	1938	287,700	620	FNARX	do	230	1,921

*Acres of water surface at top of permanent pool.
[1] Year Corps of Engineers assumed operation of the reservoir.
[2] Included with figure for Lac Qui Parle Dam.
[3] Corps of Engineers assumed operation of the 14 Muskingum River reservoirs in 1939.

Appendix D

POWER

D–1 Power Projects in Operation.

Table D–1. Power Projects in Operation

Project	Region	Initial operation fiscal year	Installed capacity (1,000 kw)	Net generation fiscal year 1961 (billion kwh)	Net generation cumulative through fiscal year 1961 (billion kwh)
Blakely Mountain, Ark.	Arkansas-Red-White.	1956	75.0	0.19	0.98
Bull Shoals, Ark. and Mo.	do	1953	160.0	.54	4.32
Denison, Okla. and Tex.	do	1945	70.0	.22	2.95
Fort Gibson, Okla.	do	1953	45.0	.20	1.07
Narrows, Ark.	do	1950	17.0	.04	.37
Norfork, Ark. and Mo.	do	1944	70.0	.19	3.03
Table Rock, Mo. and Ark.	do	1959	150.0	.38	.60
Tenkiller Ferry, Okla.	do	1954	34.0	.10	.67
Albeni Falls, Idaho	Columbia	1955	42.6	.16	1.37
Bonneville, Oreg. and Wash.	do	1938	518.4	3.18	74.20
Chief Joseph, Wash.	do	1956	1,024.0	4.53	26.28
Detroit, Oreg.	do	1954	118.0	.38	3.80
Lookout Point, Oreg.	do	1955	135.0	.30	2.67
McNary, Oreg. and Wash.	do	1954	980.0	4.54	37.47
The Dalles, Oreg. and Wash.	do	1957	1,119.0	4.39	13.09
St. Marys, Mich.	Great Lakes and St. Lawrence.	1952	18.4	.15	1.23
Fort Peck, Mont.	Missouri	1944	165.0	.76	7.72
Fort Randall, S. Dak.	do	1954	320.0	1.26	7.47
Garrison, N. Dak.	do	1956	400.0	1.27	6.01
Gavins Point, Neb. and S. Dak.	do	1957	100.0	.50	2.22
John H. Kerr, N.C. and Va.	North Atlantic	1953	204.0	.39	3.23
Philpott, Va.	do	1954	14.0	.02	.17
Center Hill, Tenn.	Ohio	1951	135.0	.38	3.87
Cheatham, Tenn.	do	1958	36.0	.19	.41
Dale Hollow, Tenn.	do	1949	54.0	.12	1.60
Old Hickory, Tenn.	do	1957	100.0	.56	2.12
Wolf Creek, Ky.	do	1952	270.0	.99	8.16
Allatoona, Ga.	South Atlantic and East Gulf.	1950	74.0	.16	1.45
Buford, Ga.	do	1957	86.0	.19	.56
Clark Hill, Ga. and S.C.	do	1953	280.0	.58	4.56
Jim Woodruff, Fla. and Ga.	do	1957	30.0	.22	.96
Whitney, Tex.	West Gulf	1954	30.0	.08	.44
Total			6,874.4	27.16	225.05

Appendix E

WATER SUPPLY AND IRRIGATION

Table E–1. Water Supply Storage

	Project	Water supply storage (acre-feet)	Local agency
	In operation		
1	Baldhill, N. Dak	[1] 69, 500	Eastern North Dakota, Water Development Association.
2	Belton, Tex	12, 000	Fort Hood, Tex.
	Do	113, 700	Brazos River Authority, Texas.
3	Berlin Dam, Ohio	19, 400	Mahoning Valley Sanitary District.
4	Burr Oak, Ohio (Tom Jenkins).	9, 300	State of Ohio.
5	Canton Dam, Okla	90, 000	Oklahoma City, Okla.
6	Clark Hill, Ga. and S.C	210	McCormick, S.C.
7	Dam B, Texas	[2] 94, 200	Lower Neches Valley Authority, Texas.
8	Ferrells Bridge, Tex	251, 100	Northeast Texas Municipal Water District.
9	Grapevine, Tex	85, 000	Dallas, Tex.
	Do	50, 000	Park Cities, Tex.
	Do	1, 250	Grapevine, Tex.
10	Heyburn, Okla	1, 000	Kiefer, Okla.
11	Homme, N. Dak	[1] 3, 650	Grafton and Park River, N. Dak.
12	Hords Creek, Tex	5, 780	Coleman, Tex.
13	Hulah, Tex	15, 400	Bartlesville, Okla.
14	Lake Texoma, Okla. and Tex.	21, 300	Denison, Tex.
15	Lavon Dam, Tex	100, 000	North Texas Municipal Water District.
16	Lewisville, Tex	415, 000	Dallas, Tex.
	Do	21, 000	Denton, Tex.
17	Mosquito Creek, Ohio	11, 000	Warren, Ohio
18	San Angelo, Tex	80, 350	Upper Colorado River Authority.
19	Texarkana, Ark. and Tex	[1] 13, 400	Cities of Texarkana, Ark. and Tex.
	Subtotal	1, 483, 540	
	Under construction		
1	Beaver, Ark	108, 000	Beaver Water District, Arkansas.
	Belton, Tex	[3] 247, 000	Brazos River Authority, Texas
2	Canyon, Tex	366, 400	Guadalupe-Blanco River Authority, Texas.
3	Carlyle, Ill	33, 000	State of Illinois.
4	Council Grove, Kans	24, 400	Council Grove and Emporia, Kans.

See footnotes at end of table.

Table E–1. Water Supply Storage—Continued

Under construction—Continued

	Project	Water supply storage (acre-feet)	Local agency
5	John Redmond, Kans	34, 900	State of Kansas.
6	McGee Bend, Tex	(4)	Lower Neches Valley Authority, Texas.
7	Milford, Kans	300, 000	State of Kansas.
8	Millwood, Ark	150, 000	Southwest Arkansas Water District.
9	Monroe, Ind	160, 000	State of Indiana.
10	Navarro Mills, Tex	53, 200	Trinity River Authority, Texas
11	Oologah, Okla	38, 000	Tulsa, Okla.
	Do	500	Collinsville, Okla.
	Do	5, 000	Public Service Co., Oklahoma.
	Do	2, 500	Claremore Foundation, Oklahoma.
12	Proctor, Tex	31, 400	Brazos River Authority, Texas.
13	Waco, Tex	91, 074	Brazos River Authority, Texas.
	Do	13, 026	Waco, Tex.
14	Wilkesboro, N.C	33, 000	Winston-Salem, N.C., and Wilkes County, N.C.
	Subtotal	1, 691, 400	
	Total	3, 174, 940	

[1] Seasonal for flood control and water supply.
[2] Much of the water is presently used for growing rice.
[3] Completed project. Additional water supply storage to be allocated from flood control storage following completion of Proctor.
[4] Water supply and power storage combined.

Table E–2. Irrigation Storage in Corps of Engineers Reservoirs

(In thousands of acre-feet)

Project	Exclusive irrigation storage	Joint-use storage
In operation		
Conchas, N. Mex	279	
Cottage Grove, Oreg		30
Detroit, Oreg		300
Dorena, Oreg		70
Fern Ridge, Oreg		95
Folsom, Calif.[1]		512
Harlan County, Nebr	150	
Isabella, Calif		535
John Martin, Colo	384	
Lookout Point, Oreg		340
Lucky Peak, Idaho		280
Pine Flat, Calif		1, 000
Success, Calif		75
Total	813	3, 237
Under construction		
Black Butte, Calif		150
New Hogan, Calif		310
Terminus, Calif		142
Wilson, Kans		225
Total		827

[1] Operated by the Bureau of Reclamation.